Supreme Court, U. S.
FILED
MAR 14 1980
MICHAEL RODAK, JR., CLERK

IN THE

Supreme Court of the United States

OCTOBER TERM 1979

Nos. ..79-1429

AMERICAN TEXTILE MANUFACTURERS INSTITUTE, INC., MILLIKEN & COMPANY, ARKWRIGHT MILLS, SPARTAN MILLS, BLAIR MILLS, INC., HERMITAGE, INC., DAN RIVER, INC., CONE MILLS CORPORATION, MAYFAIR MILLS, SPRINGS MILLS, INC., RIEGEL TEXTILE CORPORATION, FIELDCREST MILLS, INC., AND WEST POINT-PEPPERELL, INC.,

Petitioners,

v.

RAY MARSHALL, SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR,

Respondents.

APPENDIX TO PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

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CHAPTER XVII—OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

§ 1910.1043 Cotton dust.

(a) *Scope and application.* (1) This section applies to the control of employee exposure to cotton dust in all workplaces, except as provided in paragraph (a)(2) of this section.

(2) This section does not apply to: (i) The harvesting of cotton; (ii) the ginning of cotton (Exposure to cotton dust in cotton ginning is covered by § 1910.1046); (iii) maritime operations covered by 29 CFR Parts 1915, 1916, 1917, 1918; (iv) the handling or processing of woven or knitted materials; and (v) the handling or processing of washed cotton.

(3) This section provides mandatory requirements for the control of employee exposure to cotton dust. The mandatory nature of these requirements is not intended, however, to discourage or inhibit the development of different, equally effective means of providing the required protection. The variance provisions of section 6(d) of the Act, and the implementing regulations in Part 1905 of this Title, provide a mechanism for employers to obtain variances from the provisions of this section where the employer has developed alternative procedures which are "as safe and healthful as" those required by this section. As implemented by the procedural regulations in Part 1905 of this Title, the variance provisions of the Act permit the flexibility which contributes to efficient compliance with the standard. To aid in the expeditious processing of variance applications, the procedures allow, where appropriate, for the grant of interim orders pending a decision on the merits of the variance as well as for the consideration of variances applicable to groups of employers. OSHA encourages interested em-

ployers to utilize the variance provisions of the Act where equally safe and healthful protective means are available.

(b) *Definitions.* For the purpose of this section:

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor or designee;

"Blow down" means the cleaning of equipment and surfaces with compressed air.

"Cotton dust" means dust present in the air during the handling or processing of cotton, which may contain a mixture of many substances including ground up plant matter, fiber, bacteria, fungi, soil, pesticides, non-cotton plant matter and other contaminants which may have accumulated with the cotton during the growing, harvesting and subsequent processing or storage periods. Any dust present during the handling and processing of cotton through the weaving or knitting of fabrics, and dust present in other operations or manufacturing processes using new or waste cotton fibers or cotton fiber by-products from textile mills are considered cotton dust.

"Director" means the Director of the National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health, Education, and Welfare, or designee;

"Lint-free respirable cotton dust" means particles of cotton dust of approximately 15 microns or less aerodynamic equivalent diameter;

"Vertical elutriator cotton dust sampler" means a dust sampler which has a particle size cut-off at approximately 15 microns aerodynamic equivalent diameter when operating at the flow rate of 7.4 ± 0.2 liters per minute;

"Yarn manufacturing" means all textile mill operations from opening to, but not including, slashing and weaving;

"Washed cotton" means cotton which has been thoroughly washed in hot water and is known in the cotton textile trade

as purified or dyed. Washed cotton does not include steamed, autoclaved cotton or cotton washed solely in solvents.

(c) *Permissible exposure limits.* (1) the employer shall assure that no employee who is exposed to cotton dust in yarn manufacturing is exposed to airborne concentrations of lint-free respirable cotton dust greater than 200 ug/m^3 mean concentration, averaged over an eight-hour period, as measured by a vertical elutriator or a method of equivalent accuracy and precision.

(2) The employer shall assure that no employee who is exposed to cotton dust in the textile processes known as slashing and weaving is exposed to airborne concentrations of lint-free respirable cotton dust greater than 750 ug/m^3 mean concentration, averaged over an eight hour period, as measured by a vertical elutriator or a method of equivalent accuracy and precision.

(3) The employer shall assure that no employee who is exposed to cotton dust (except for exposures in yarn manufacturing and slashing and weaving covered by paragraphs (c)(1) and (c)(2) of this section is exposed to airborne concentrations of lint-free respirable cotton dust greater than 500 ug/m^3 mean concentration, averaged over an eight-hour period, as measured by a vertical elutriator or a method of equivalent accuracy and precision.

(d) *Exposure monitoring and measurement*—(1) *General.* (i) For the purposes of this section, employee exposure is that exposure which would occur if the employee were not using a respirator.

(ii)) The sampling device to be used shall be either the vertical elutriator cotton dust sampler or a method of equivalent accuracy and precision.

(iii) If an alternative to the vertical elutriator cotton dust sampler is used, the employer shall establish equivalency by demonstrating that the alternative sampling

devices;

(*a*) Collect respirable particulates in the same range as the vertical elutriator (approximately 15 microns);

(*b*) Replicate exposure data in side-by-side field comparisons; and

(*c*) Are equivalent within an accuracy and precision range of plus or minus 25 percent for 95 percent of the samples over the range of 0.5 to 2 times the permissible exposure limit.

(2) *Initial monitoring.* Each employer who has a place of employment in which cotton dust is present, shall conduct monitoring by obtaining measurements which are representative of the exposure of all employees to airborne concentrations of lint-free respirable cotton dust over an eight-hour period. The sampling program shall include at least one determination during each shift for each work area.

(3) *Periodic monitoring.* (i) The employer shall repeat the measurements required by paragraph (d)(2) of this section at least every six months.

ii) Whenever there has been a production, process, or control change which may result in new or additional exposure to cotton dust, or whenever the employer has any other reason to suspect an increase in employee exposure, the employer shall repeat the monitoring and measurements required by paragraph (d)(2) of this section for those employees affected by the change or increase.

(4) *Employee notification.* (i) Within five working days after the receipt of monitoring results, the employer shall notify each employee in writing of the exposure measurements which represent that employee's exposure.

(ii) Whenever the results indicate that the employee's exposure exceeds the applicable permissible exposure limit specified in paragraph (c) of this section, the employer shall include in the written notice a statement that the per-

missible exposure limit was exceeded and a description of the corrective action taken to reduce exposure below the permissible exposure limit.

(e) *Methods of compliance*—(1) *Engineering and work practice controls.* The employer shall institute engineering and work practice controls to reduce and maintain employee exposure to cotton dust at or below the permissible exposure limit specified in paragraph (c) of this section, except to the extent that the employer establishes that such controls are not feasible.

(2) Whenever feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the permissible exposure limit, the employer shall nonetheless institute these controls to immediately reduce exposure to the lowest feasible level, and shall supplement these controls with the use of respirators which shall comply with the provisions of paragraph (f) of this section.

(3) *Compliance program.* (i) Each employer shall establish and implement a written program sufficient to reduce exposures to or below the permissible exposure limit solely by means of engineering controls and work practices as required by paragraph (e)(1) of this section.

(ii) The written program shall include at least the following:

(*a*) A description of each operation or process resulting in employee exposure to cotton dust;

(*b*) Engineering plans and other studies used to determine the controls for each process;

(*c*) A report of the technology considered in meeting the permissible exposure limit;

(*d*) Monitoring data obtained in accordance with paragraph (d) of this section;

(*e*) A detailed schedule for development and implementation of engineering and work practice controls, including

exposure levels projected to be achieved by such controls;

(*f*) Work practice program; and

(*g*) Other relevant information.

(iii) The employer's schedule as set forth in the compliance program, shall project completion of the compliance program no later than September 4, 1982,

(iv) The employer shall complete the steps set forth in his program by the dates in the schedule.

(v) Written programs shall be submitted, upon request, to the Assistant Secretary and the Director, and shall be available at the worksite for examination and copying by the Assistant Secretary, the Director, and any affected employee or their designated representatives.

(vi) The written programs required under paragraph (e)(3) of this section shall be revised and updated at least every six months to reflect the current status of the program and current exposure levels.

(4) *Mechanical ventilation.* When mechanical ventilation is used to control exposure, measurements which demonstrate the effectiveness of the system to control exposure, such as capture velocity, duct velocity, or static pressure shall be made at least every six months. Measurements of the system's effectiveness to control exposures shall also be made within five days of any change in production, process or control which may result in any increase in airborne concentrations of cotton dust.

(f) *Use of respirators*—(1) *General.* Where the use of respirators is required under this section, the employer shall provide, at no cost to the employee, and assure the use of respirators which comply with the requirements of this paragraph (f). Respirators shall be used in the following circumstances:

(i) During the time periods necessary to install or implement feasible engineering controls and work practice controls;

(ii) During maintenance and repair activities in which engineering and work practice controls are not feasible;

(iii) In work situations where feasible engineering and work practice controls are not yet sufficient to reduce exposure to or below the permissible exposure limit; and

(iv) In operations specified under paragraph (g)(1).

(v) Whenever an employee requests a respirator.

(2) *Respirator selection.* (i) Where respirators are required under this section, the employer shall select the appropriate respirator from Table 1 below and shall assure that the employee uses the respirator provided.

TABLE I

Cotton dust concentration	*Required respirator*
Not greater than—	
(a) 5 × the applicable permissible exposure limit.	1. Any dust respirator, including single use.
(b) 10 × the applicable permissible exposure limit.	1. Any dust respirator, except single use or quarter mask; or 2. Any supplied air respirator; or 3. Any self-contained breathing apparatus.
(c) 100 × the applicable permissible exposure limit.	1. High efficiency particulate filter respirator with a full facepiece; or 2. Any supplied air respirator with full-facepiece, helmet or hood; or 3. Any self-contained breathing apparatus with full-facepiece.
(d) Greater than 100 × the applicable permissible exposure limit.	1. A powered air-purifying respirator with high efficiency particulate filter; or 2. A self-contained breathing apparatus with a full-facepiece op-

Cotton dust concentration	*Required respirator*
	erated in pressure demand or other positive pressure mode; or 3. A type "C" supplied air respirator operated in pressure demand or other positive pressure mode; or 4. A combination respirator which includes a type C supplied-air respirator with a full-facepiece operated in pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure demand or other positive pressure mode.

(ii) The employer shall select respirators from those tested and approved for protection against dust by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11.

(iii) Whenever respirators are required by this section for concentrations not greater than 5 x the applicable permissible exposure limit, the employer shall provide and permit the employee to use, at the employee's option, single use dust respirator in preference to any respirator specified in paragraph (a) of Table 1.

(iv) Whenever respirators are required by this section for concentrations not greater than 100 x the applicable permissible exposure limit, the employer shall, upon the request of the employee, provide a powered air purifying respirator with a high efficiency particulate filter in lieu of the respirator specified in paragraphs (a), (b), or (c) of Table I.

(v) Whenever a physician determines that an employee is unable to wear any form of respirator, including a power

air purifying respirator, the employee shall be given the opportunity to transfer to another position which is available or which later becomes available having a dust level at or below the PEL. The employer shall assure than an employee who is transferred due to an inability to wear a respirator suffers no loss of earnings or other employment rights or benefits as a result of the transfer.

(vi) Until March 4, 1979, the employer shall provide any dust respirator, including single use, to all employees exposed to cotton dust, unless the employer has conducted the monitoring required by paragraph (d)(2) of this section or otherwise has monitored employee exposure. As soon as monitoring has been conducted, the employer shall select the appropirate respirator from Table I.

(3) *Respirator program.* The employer shall institute a respirator program in accordance with § 1910.134 (b), (d), (e), and (f) of this part.

(4) *Respirator usage.* (i) The employer shall assure that the respirator used by each employee exhibits minimum facepiece leakage and that the respirator is fitted properly.

(ii) The employer shall allow each employee who uses a filter respirator, to change the filter elements whenever an increase in breathing resistance is detected by the employee. The employer shall maintain an adequate supply of filter elements for this purpose.

(iii) The employer shall allow employees who wear respirators to wash their faces and respirator face pieces to prevent skin irritation associated with respirator use.

(g) *Work practices.* Each employer shall, regardless of the level of employee exposure, immediately establish and implement a written program of work practices, which shall minimize cotton dust exposure for each specific job. Where applicable, the following work practices shall be included in the work practices program:

(1) Compressed air "blow down" cleaning shall be prohibited, where alternative means are feasible. Where compressed air "blow down" is done, respirators shall be worn by the employees performing the "blow down", and employees in the area whose presence is not required to perform the "blow down" shall be required to leave the area during this cleaning operation.

(2) Cleaning of clothing or floors with compressed air shall be prohibited.

(3) Floor sweeping shall be performed with a vacuum or with methods designed to minimize dispersal of dust.

(4) Cotton and cotton waste shall be stacked, sorted, baled, dumped, removed or otherwise handled by mechanical means, except where the employer can show that it is infeasible to do so. Where infeasible, the method used for handling cotton and cotton waste shall be the method which reduces exposure to the lowest level feasible.

(5) The employer shall inspect, clean, maintain, and repair, all engineering control equipment and ventilation systems including power sources, ducts, and filtration units of the equipment.

(h) *Medical surveillance*—(1) *General.* (i) Each employer who has a place of employment in which cotton dust is present shall institute a program of medical surveillance for all employees exposed to cotton dust.

(ii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician and are provided without cost to the employee.

(iii) Persons other than licensed physicians, who administer the pulmonary function testing required by this section shall complete a NIOSH approved training course in spirometry.

(2) *Initial examinations.* The employer shall provide each employee who is or may be exposed to cotton dust with an opportunity for medical surveillance. For new employees this examination shall be provided prior to initial assignment. The medical surveillance shall include at least the following:

(i) A medical history;

(ii) The standardized questionnaire contained in Appendix B; and

(iii) A pulmonary function measurement, including a determination of forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV_1), and the percentage that the measured values of FEV and FVC differ from the predicted values, using the standard tables in Appendix C. The predicted FEV_1 and FVC for blacks shall be multiplied by 0.85 to adjust for ethnic differences.

These determinations shall be made for each employee before the employee enters the workplace on the first day of the work week, following at least 35 hours after previous exposure to cotton dust. The tests shall be repeated during the shift, no sooner than 4 and no more than 10 hours after the beginning of the work shift; and, in any event, no more than one hour after cessation of exposure.

(iv) Based upon the questionnaire results, each employee shall be graded according to Schilling's byssinosis classification system.

(3) *Periodic examinations.* (i) The employer shall provide annual medical surveillance for all employees exposed to cotton dust which shall include at least an update of the medical history and standardized questionnaire (the abbreviated questionnaire, App. B-III) and the pulmonary function measurements in paragraph (h)(2) of this section.

(ii) Medical surveillance as required in paragraph (h)

(3)(i) of this section shall be provided every six months for all employees in the following categories:

(*a*) An FEV_1 of greater than 80 percent of the predicted value, but with an FEV_1 decrement of 5 percent or 200 ml. on a first working day;

(*b*) An FEV_1 of less than 80 percent of the predicted value; or

(*c*) Where, in the opinion of the physician, any significant change in questionnaire findings, pulmonary function results, or other diagnostic tests has occurred.

(ii) An employee whose FEV_1 is less than 60 percent of the predicted value shall be referred to a physician for a detailed pulmonary examination.

(iv) A comparison shall be made between the current examination results and those of previous examinations and a determination made by the physician as to whether there has been a significant change.

(4) *Information provided to the physician.* The employer shall provide the following information to the examining physician:

(i) A copy of this regulation and its Appendices;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The employee's exposure level or anticipated exposure level;

(iv) A description of any personal protective equipment used or to be used; and

(v) Information from previous medical examinations of the affected employee which is not readily available to the examining physician.

(5) *Physician's written opinion.*

(i) The employer shall obtain and furnish the employee

with a copy of a written opinion from the examining physician containing the following:

(*a*) The results of the medical examination and tests;

(*b*) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from exposure to cotton dust;

(*c*) The physician's recommended limitations upon the employee's exposure to cotton dust or upon the employee's use of respirators including a determination of whether an employee can wear a negative pressure respirator, and where the employee cannot, a determination of the employee's ability to wear a powered air purifying respirator; and

(*d*) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposure.

(i) *Employee education and training* — (1) *Training program.* (i) The employer shall provide a training program for all employees in all workplaces where cotton dust is present, and shall assure that each employee in these workplaces is informed of the following:

(*a*) The specific nature of the operations which could result in exposure to cotton dust at or above the permissible exposure limit;

(*b*) The measures, including work practices required by paragraph (g) of this section, necessary to protect the employee from exposures in excess of the permissible exposure limit;

(*c*) The purpose, proper use and limitations of respirators required by paragraph (f) of this section;

(*d*) The purpose for and a description of the medical surveillance program required by paragraph (h) of this section and other information which will aid exposed employees in understanding the hazards of cotton dust exposure; and

(*e*) The contents of this standard and its appendices.

(ii) The training program shall be provided prior to initial assignment and shall be repeated at least annually.

(2) *Access to training materials.* (i) Each employer shall post a copy of this section with its appendices in a public location at the workplace, and shall, upon request, make copies available to employees.

(ii) The employer shall provide all materials relating to the employee training and information program to the Assistant Secretary and the Director upon request.

(iii) In addition to the information required by paragraph (i)(1) of this section, the employer shall include as part of the training program, and shall distribute to employees, any materials, pertaining to the Occupational Safety and Health Act, the regulations issued pursuant to that Act, and this cotton dust standard, which are made available to the employer by the Assistant Secretary.

(j) *Signs.* The employer shall post the following warning sign in each work area where the permissible exposure limit for cotton dust is exceeded:

WARNING
COTTON DUST WORK AREA
MAY CAUSE ACUTE OR DELAYED LUNG INJURY
(BYSSINOSIS)
RESPIRATORS
REQUIRED IN THIS AREA

(k) *Recordkeeping*—(1) *Exposure measurements.* (i) The employer shall establish and maintain an accurate record of all measurements required by paragraph (d) of this section.

(ii) The record shall include: (*a*) A log containing the items listed in paragraph IV (a) of Appendix A, and the dates, number, duration, and results of each of the samples taken, including a description of the procedure used to determine representative employee exposures;

(*b*) The type of protective devices worn, if any, and length of time worn; and

(*c*) The names, social security numbers, job classifications, and exposure levels of employees whose exposure the measurement is intended to represent.

(iii) The employer shall maintain this record for at least 20 years.

(2) *Medical surveillance.* (i) The employer shall establish and maintain an accurate medical record for each employee subject to medical surveillance required by paragraph (h) of this section.

(ii) The record shall include:

(*a*) The name and social security number and description of the duties of the employee;

(*b*) A copy of the medical examination results including the medical history, questionnaire responses, results of all tests, and the physician's recommendation;

(*c*) A copy of the physician's written opinion;

(*d*) Any employee medical complaints related to exposure to cotton dust;

(*e*) A copy of this standard and its appendices, except that the employer may keep one copy of the standard and the appendices for all employees, provided that he references

the standard and appendices in the medical surveillance record of each employee; and

(*f*) A copy of the information provided to the physician as required by paragraph (h)(4) of this section.

(iii) The employer shall maintain this record for at least 20 years.

(3) *Availability.* (i) The employer shall make all records required to be maintained by paragraph (k) of this section available to the Assistant Secretary and the Director for examination and copying.

(ii) The employer shall make employee exposure measurement records required by this section available to affected employees or their designated representatives for examination and copying.

(iii) The employer shall make all records indicating a former employee's own exposure to cotton dust available to the former employee or his designated representative for examination and copying.

(iv) The employer shall make an employee's medical records required to be maintained by this section, available to the affected employee or former employee or to a physician or other individual designated by such affected employee or former employees, for examination and copying.

(4) *Transfer of records,* (i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by paragraph (k) of this section.

(ii) Whenever the employer ceases to do business, and there is no successor employer to receive and retain the records for the prescribed period, these records shall be transmitted to the Director.

(iii) At the expiration of the retention period for the records required to be maintained by this section, the em-

ployer shall notify the Director at least 3 months prior to the disposal of such records and shall transmit those records to the Director if he requests them within that period.

(l) *Observation of monitoring.* (1) The employer shall provide affected employees or their designated representatives an opportunity to observe any measuring or monitoring of employee exposure to cotton dust conducted pursuant to paragraph (d) of this section.

(2) Whenever observation of the measuring or monitoring of employee exposure to cotton dust requires entry into an area where the use of personal protective equipment is required, the employer shall provide the observer with and assure the use of such equipment and shall require the observer to comply with all other applicable safety and health procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) An explanation of the measurement procedures;

(ii) An opportunity to observe all steps related to the measurement of airborne concentrations of cotton dust performed at the place of exposure; and

(iii) An opportunity to record the results obtained.

(m) *Effective date*—(1) *General.* This section is effective September 4, 1978, except as otherwise provided below.

(2) *Startup dates.* (i) *Initial monitoring.* The initial monitoring required by paragraph (d)(2) of this section shall be completed as soon as possible but no later than March 4, 1979.

(ii) *Methods of compliance: Engineering and work practice controls.* The engineering and work practice controls required by paragraph (e) of this section shall be implemented no later than September 4, 1982.

(iii) *Compliance program.* The compliance program re-

quired by paragraph (e)(3) of this section shall be established no later than September 4, 1979.

(iv) *Respirators.* The respirators required by paragraph (f) of this section shall be provided no later than October 4, 1978. Until March 4, 1979, the provisions of paragraph (f)(2)(vi) apply.

(v) *Work practices.* The work practices required by paragraph (g) of this section shall be implemented no later than December 4, 1978.

(vi) *Medical surveillance.* The medical surveillance required by paragraph (h) of this section shall be completed no later than September 4, 1979.

(vii) *Employee education and training.* The initial education and training required by paragraph (i) of this section shall be completed as soon as possible but no later than December 4, 1978.

(n) *Appendices.* (i) Appendices B, C, and D to this section are incorporated as part of this section and the contents of these appendices are mandatory.

(ii) Appendix A contains information which is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

Notice: This opinion is subject to formal revision before publication in the Federal Reporter or U.S.App.D.C. Reports. Users are requested to notify the Clerk of any formal errors in order that corrections may be made before the bound volumes go to press.

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 78-1562

AMERICAN FEDERATION OF LABOR & CONGRESS OF INDUSTRIAL ORGANIZATIONS, *et al.*, PETITIONERS

v.

RAY MARSHALL, SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, *et al.*, RESPONDENTS

No. 78-1736

COTTON WAREHOUSE ASSOCIATION, PETITIONER

v.

RAY MARSHALL, SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, AND EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, U.S. DEPARTMENT OF LABOR AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, U.S. DEPARTMENT OF LABOR

Bills of costs must be filed within 14 days after entry of judgment. The court looks with disfavor upon motions to file bills of costs out of time.

No. 78-1979

AMERICAN TEXTILE MANUFACTURERS INSTITUTE, INC., PETITIONER

v.

DR. EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS; INDUSTRIAL UNION DEPARTMENT, AFL-CIO; AND AMALGAMATED CLOTHING AND TEXTILE WORKERS UNION, AFL-CIO, CLC, INTERVENORS

No. 78-1980

AMERICAN TEXTILE MANUFACTURERS INSTITUTE, INC., PETITIONER

v.

DR. EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

AFL-CIO, ETC., INTERVENORS

No. 78-1981

AMERICAN TEXTILE MANUFACTURERS INSTITUTE, INC., PETITIONER

v.

DR. EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

AFL-CIO, ETC., INTERVENORS

No. 78-1982

MILLIKEN AND COMPANY, PETITIONER

v.

RAY MARSHALL, SECRETARY OF LABOR AND DR. EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, RESPONDENTS

No. 78-1983

ARKWRIGHT MILLS, PETITIONER

v.

F. RAY MARSHALL, SECRETARY, DEPARTMENT OF LABOR, AND EULA BINGHAM, ASSISTANT SECRETARY OF LABOR FOR OCCUPATIONAL SAFETY AND HEALTH, RESPONDENTS

No. 78-1984

SPARTAN MILLS, PETITIONER

v.

F. RAY MARSHALL, SECRETARY, DEPARTMENT OF LABOR, AND EULA BINGHAM, ASSISTANT SECRETARY OF LABOR FOR OCCUPATIONAL SAFETY AND HEALTH, RESPONDENTS

No. 78-1986

BLAIR MILLS, INC., PETITIONER

v.

F. RAY MARSHALL, SECRETARY, DEPARTMENT OF LABOR, AND EULA BINGHAM, ASSISTANT SECRETARY OF LABOR FOR OCCUPATIONAL SAFETY AND HEALTH, RESPONDENTS

No. 78-1987

HERMITAGE, INC., PETITIONER

v.

F. RAY MARSHALL, SECRETARY, DEPARTMENT OF LABOR, AND EULA BINGHAM, ASSISTANT SECRETARY OF LABOR FOR OCCUPATIONAL SAFETY AND HEALTH, RESPONDENTS

No. 78-1988

DAN RIVER, INC., PETITIONER

v.

DR. EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

No. 78-1989

CONE MILLS CORPORATION, PETITIONER

v.

RAY MARSHALL, SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, AND EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

No. 78-1990

MAYFAIR MILLS, PETITIONER

v.

F. RAY MARSHALL, SECRETARY, DEPARTMENT OF LABOR, AND EULA BINGHAM, ASSISTANT SECRETARY OF LABOR FOR OCCUPATIONAL SAFETY AND HEALTH, RESPONDENTS

No. 78-1991

SPRINGS MILLS, INC., PETITIONER

v.

RAY MARSHALL, SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, DR. EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

No. 78-1992

RIEGEL TEXTILE CORPORATION, PETITIONER

v.

RAY MARSHALL, SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, AND THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

No. 78-1993

FIELDCREST MILLS, INC., PETITIONER

v.

F. RAY MARSHALL, SECRETARY OF LABOR, AND DR. EULA BINGHAM, ASSISTANT SECRETARY OF LABOR FOR OCCUPATIONAL SAFETY AND HEALTH, AND THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

No. 78-2013

AMERICAN COTTON SHIPPERS ASSOCIATION, PETITIONER

v.

DR. EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, AND OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

No. 78-2014

NATIONAL COTTONSEED PRODUCTS ASSOCIATION, PETITIONER

v.

RAY MARSHALL, SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR AND EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

No. 78-2016

NATIONAL COTTON COUNCIL OF AMERICA, PETITIONER

v.

RAY MARSHALL, SECRETARY OF LABOR, EULA BINGHAM, ASSISTANT SECRETARY OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, UNITED STATES DEPARTMENT OF LABOR, RESPONDENTS

No. 78-2018

WEST POINT-PEPPERELL, INC., PETITIONER

v.

RAY MARSHALL, SECRETARY OF LABOR AND
EULA BINGHAM, ASSISTANT SECRETARY OF LABOR,
RESPONDENTS

Argued February 14, 1979

Decided October 24, 1979

Judgment entered this date ←

George H. Cohen with whom *Robert M. Weinberg, Jeremiah A. Collins, David M. Silberman, Laurence Gold, Judith Kincaid, J. Albert Woll, Elliot Bredhoff* and *Arthur M. Goldberg* were on the brief, for AFL-CIO, et al. petitioner in No. 78-1562, and intervenors in Nos. 78-1979, 78-1980 and 78-1981.

Robert E. Payne with whom *John S. Battle, Jr., Gregory B. Tobin, Edward W. Warren* and *Arthur F. Sampson III* were on the brief, for petitioners American Textile Manufacturers Institute, Inc., et al. in Nos. 78-1562, 78-1979, 78-1980, 78-1981 and 78-1993.

Harlan H. Huntley and *Roger L. Tuttle* were on the brief, for petitioner Dan River, Inc. in No. 78-1988.

Robert T. Thompson with whom *Gary S. Klein* was on the brief, for petitioner Milliken and Company in Nos. 78-1982, 78-1986 and 78-1987.

Samuel K. Abrams and *Brian E. Moran* were on the brief, for petitioner Cone Mills Corp. in No. 78-1989.

Before BAZELON, *Senior Circuit Judge*, and TAMM and ROBINSON, *Circuit Judges*.

Opinion for the Court filed by *Senior Circuit Judge* BAZELON.

BAZELON, *Senior Circuit Judge*: These consolidated petitions [1] for review challenge a new permanent health standard limiting occupational exposure to cotton dust,[2] which was promulgated by regulation on June 19, 1978 by the Occupational Safety and Health Administration of the Department of Labor (OSHA), under section 6(b)(5) of the Occupational Safety and Health Act of 1970 (the Act).[3] OSHA's action, which rests on its determination that occupational exposure to cotton dust presents a material health hazard to workers, is attacked by

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[1] Petitions in addition to those on review here, *see* notes 4-6, *infra*, were filed by representatives of the cotton waste processing industries and users of cotton batting: the National Association of Bedding Manufacturers (No. 78-1784); the National Association of Furniture Manufacturers (No. 78-1796); the Textile Fibers and By-Products Association (No. 78-1985); the National Cotton Batting Institute (No. 78-2015); and, the Wolf Corporation (No. 78-2017). These petitioners were severed from this case on November 1, 1978, when OSHA suspended application of the standard to these industries. *See* 43 Fed. Reg. 38087 (1978); 44 Fed. Reg. 5438 (1979).

[2] Standard for Occupational Exposure to Cotton Dust, 43 Fed. Reg. 27350-99 (June 19, 1978), as amended, 43 Fed. Reg. 28473-74 (June 30, 1978), 43 Fed. Reg. 35032-35 (August 8, 1978), 43 Fed. Reg. 56893-94 (December 5, 1978) [hereinafter "the standard"].

[3] 83 Stat. 1594, 29 U.S.C. § 655(b) (1976). The Secretary of Labor delegated his authority to promulgate occupational safety and health standards under 29 U.S.C. § 655 (1976) to the Assistant Secretary of Labor of Occupational Safety and Health ("the Secretary"), who is the chief executive officer of OSHA. References in this opinion to "the Secretary" and "OSHA" are used interchangeably.

three groups of petitioners: (1) representatives of the cotton textile industry[4] and (2) nontextile industries[5] who claim that the standard is unwarranted and infeasible; and (3) their employee unions, who attack two provisions of the standard as too lax, but support the rest.[6] These very divergent claims reflect the wide variety of conflicting interests that make OSHA's task a difficult one. On direct review,[7] we uphold the standard except for its application to the cottonseed oil industry which we remand for clarification or reconsideration.

To assist a proper understanding of the issues, we discuss (I) the history and context of the agency's action; (II) the nature of our review under the Act; (III) the

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[4] The textile industry petitioners include the American Textile Manufacturers Institute, Inc. (ATMI) (Nos. 78-1979, 78-1980, and 78-1981) and twelve individual companies engaged in the manufacture of textiles from cotton: Milliken and Company (No. 78-1982); Arkwright Mills (No. 78-1983); Spartan Mills (No. 78-1984); Blair Mills, Inc. (No. 78-1986); Hermitage, Inc. (No. 78-1987); Dan River, Inc. (No. 78-1988); Cone Mills Corp. (No. 78-1989); Mayfair Mills (No. 78-1990); Springs Mills, Inc. (No. 78-1991); Riegel Textile Corp. (No. 78-1992); Fieldcrest Mills, Inc. (No. 78-1993); and West Point-Pepperell, Inc. (No. 78-2018).

[5] The non-textile industries are represented by the National Cottonseed Products Association (No. 78-2014), the American Cotton Shippers Association (No. 78-2013), and the Cotton Warehouse Association (No. 78-1736). A petition also was filed on behalf of the entire cotton industry of the National Cotton Council of American (NCCA) (No. 78-2016).

[6] The employee unions are represented by the American Federation of Labor & Congress of Industrial Organizations (AFL-CIO), its Industrial Union Department, and their affiliate, the Amalgamated Clothing and Textile Workers Union (the unions) (No. 78-1562).

[7] The Act permits any person adversely affected by a health and safety standard to challenge its validity in the courts of appeals. 29 U.S.C. § 655(f) (1976).

claims of the textile industry; (IV) the claims of the non-textile industries; and (V) challenges to a few technical provisions of the standard.

I. Background

A. *Health Risks*

Health impairments associated with exposure to cotton dust range from acute but reversible reactions to irreversible, chronic obstructive pulmonary disease.[8] Cotton dust exposure can produce or aggravate respiratory symptoms characteristic of chronic bronchitis, asthma, and emphysema.[9] Further, a specific, debilitating disease has been conclusively attributed to the effect of cotton dust on the respiratory passages. This disease, named byssinosis, is more commonly known in its chronic stage as "brown lung disease."[10] This is the most serious health hazard for cotton workers.

Although the prevalence of the disease among cotton workers has been known for centuries,[11] its exact etiology

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[8] 43 Fed. Reg. 27352, 37354 (1978).

[9] 41 Fed. Reg. 56500 (1976); 43 Fed. Reg. 27352-54 (1978).

[10] OSHA observed that "byssinosis represents a constellation of respiratory effects." 43 Fed. Reg. 27353 (1978) (citations omitted).

[11] In 1705, the Italian Bernardino Ramazzi wrote that

> those who hackle in the flax and hemp to prepare it for being spun and wove, afford frequent instances of the unwholesomeness of their trade; for there flies out of this matter a foul mischeivous powder, that entering the lungs by the mouth and throat, causes continual coughs and gradually makes way for an asthma. . . . But in the long run if they find their affliction grows upon them they must look out for another trade; for 'tis a sordid profit that's accompanied with the destruction of health.

B. Ramazzini, A Treatise of the Diseases of Tradesmen (London, 1705) (quoted in J. Merchant, *Epidemological*

is still not completely understood.[12] The subjective nature of many early symptoms[13] and variations in the composition of cotton dust[14] have compounded the uncer-

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Studies of Respiratory Disease Among Cotton Textile Workers: 1970-1973 at 1 (1973), Joint Appendix (J.A.) (1497). *See also* 41 Fed. Reg. 56500 (1976).

[12] *E.g.*, 43 Fed. Reg. 27352 (1978); Bouhuys, Breathing Physiology, Environment and Lung, Disease, 418-25 9, J.A. 288-95.

[13] A major technique for diagnosing byssinosis is to ask individuals about their symptoms. A. Bouhuys, Byssinosis in the United States, 14-15, J.A. 230-31; S. Roach & R. Schilling, *A Clinical and Environmental Study of Byssinosis in the Lancashire Cotton Industry*, 17 BRIT. J. INDUS. MED. 1-3 (1959), J.A. 201-203. Workers who fear losing their jobs upon signs of ill-health or whose language facilities impair their ability to answer questions about their symptoms may not accurately report their health impairments.

Other workers may experience severe symptoms and yet not be diagnosed with the disease. *Compare, e.g.*, J.A. 2120 (testimony of Eva Bradshaw) ("Along about 5 or 10 years before I had to come out of the mill my chest would get so tight it felt just like an accordian that had closed down, like it was squeezed shut as tight as it would go. I coughed all the time, especially at work.") *with* J.A. 2057-58 (supplemental submission of Harold Imbus of Burlington Industries) (asserting that physicians did not diagnose Eva Bradshaw with byssinosis).

[14] The composition of cotton dust varies in different industries, plants, and stages of manufacturing. NIOSH, Criteria for a Recommended Standard: Occupational Exposure to Cotton Dust 86-90 (1974), J.A. 98-102. NIOSH noted that recent epidemological and expimental evidence suggests that the substances causing byssinosis is some unknown biologically active material carried with the inorganic dust into the lungs of exposed workers. *Id.* at 96, J.A. at 108. But NIOSH concluded that insufficient information is available to support this theory. *Id. accord.*, J.A. 1216-17 (comments of A. Bouhuys).

[Continued]

tainties about the actual way in which cotton dust exposure causes serious health impairments.[15] Nonetheless, its progressively disabling symptoms are well documented.[16]

Typically, a person suffering from byssinosis is initially affected by irritated air passages, coughing, breathlessness, and chest tightness. These symptoms are often accompanied by decreased pulmonary functioning, evidenced by objective indicators. At first the symptoms tend to last briefly, and usually remit a few days after exposure. The symptoms recur, however, whenever an affected individual returns to a dusty environment.

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[14] [Continued]

Therefore, OSHA applied its standard to a broad definition of cotton dust. 43 Fed. Reg. 27354. *See id.* at 27395, (to be codified at 29 C.F.R. 1910.1043(b)):

> "Cotton dust" means dust present in the air during the handling or processing of cotton, which may contain a mixture of many substances, including ground up plant matter, fiber, bacteria, fungi, soil, pesticides, non-cotton plant matter and other contaminants which may have accumulated with the cotton during the growing, harvesting and subsequent processing or storage periods. Any dust present during the handling and processing of cotton through the weaving or knitting of fabrics, and dust present in other operations or manufacturing processes using new or waste cotton fibers or cotton fiber by-products from textile mills are considered cotton dust.

[15] *E.g.*, J.A. 1214 (statement of A. Bouhuys); J.A. 317 (Hygiene Standards for Cotton Dust, British Occupational Hygiene Society Committee on Hygiene Standards); J.A. 339 (R. Schilling, Byssinosis in Cotton and Other Textile Workers). *See* 43 Fed. Reg. 27355 (citing more studies).

[16] NIOSH, Criteria for a Recommended Standard: Occupational Exposure to Cotton Dust 23-36 (1974), J.A. 33-46 (citing studies); R. Nader, *The Cotton-Mill Killer*, THE NATION (March 15, 1971), J.A. 2435. The description of the disease that follows in text relies on these reports.

As the disease progresses, its symptoms become more pronounced and painful, resembling the effects of bronchitis and asthma. They persist throughout the work week, or period of exposure. During this stage, an affected worker may become temporarily incapacitated and may need to take short but frequent leaves from work.

When byssinosis reaches its advanced stage, the worker exhibits the symptoms of emphysema and chronic bronchitis. Ultimately, irreversible lung damage results. A worker afflicted with chronic byssinosis is forced into premature retirement, often after painful efforts to remain on the job. Such individuals must give up all activities that require any physical exertion. The permanent lung damage caused by byssinosis makes every breath painful and difficult. The excess strain these breathing difficulties place on the heart often leads to the worker's early death from heart failure.

The actual number of persons afflicted with byssinosis is not certain, but it is large. One study estimated that 35,000 people have "disabling loss of lung function related to their work in the cotton textile industry" alone.[17] The Senate Report on the Occupational Safety and Health Act stated that as many as 100,000 active or retired workers suffered from the disease in 1970.[18]

Studies in the record estimate that 250,000 to 800,000 workers are exposed daily to cotton dust and its attend-

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[17] J.A. 1214 (statement of A. Bouhuys); *see* A. Bouhuys, *et. al*, Epidemiology of Chronic Lung Disease in a Cotton Mill Community, J.A. 3165.

[18] 91st Cong., 2d Sess. 3 (1970), *reprinted in* S. REP. No. 91-1282, LEGISLATIVE HISTORY OF THE OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970, at 143 (1971) [hereinafter cited as LEGIS. HIST.].

it risks.[19] As the reported incidence of the disease usually ranges as high as 20-30% of the work force in cotton industries,[20] each worker faces a substantial risk of health impairment.[21]

B. *History of Cotton Dust Regulation*

Prior to the creation of OSHA, a private association of governmental industrial hygienists placed cotton dust on its tentative list of substances for which specific exposure limits should be established.[22] In 1966 this organization adopted a "threshold limit value" of 1000 micrograms per cubic meter (1000 $\mu g/m^3$) of total dust.[23]

The federal government first regulated cotton dust in 1968. At that time, the Secretary of Labor, acting pursuant to the Walsh-Healey Act,[24] promulgated a 1000 $\mu g/m^3$ maximum total dust exposure as an occupational health requirement for public contractors.[25]

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[19] R. NADER, *supra* note 16, J.A. 2435 (estimating 250,000 textile workers exposed); Statement of Sidney M. Wolfe and Peter Greene, Public Citizen's Health Research Group, J.A. 3137 (estimating 800,000 cotton workers exposed).

[20] *See, e.g.*, J.A. 230 (20%-30% of people in carding rooms of textile mills affected with byssinosis) (A. Bouhuys, Byssinosis in the United States); J.A. 241 (20% of workings in preparation area of textile plant exhibit byssinosis symptoms) (J. Merchant, *et. al.*, Byssinosis and Chronic Bronchitis Among Cotton Textile Workers).

[21] The actual risk may vary according to the nature of the cotton dust and the extent of an individual's exposure.

[22] 43 Fed. Reg. 27351 (1978) (describing American Conference of Governmental Industrial Hygienists).

[23] *Id.*

[24] 41 U.S.C. § 35(e) (1976). *See* 43 Fed. Reg. 27351 (1978).

[25] The 1000 $\mu g/m^3$ total dust standard was based on a study that was published in 1960. Conducted by Roach and Schilling, the study examined cotton mills in Lancaster England. This study is reprinted in the Joint Appendix (J.A. at 201.

This was an interim standard adopted upon passage of the Act in 1970 in which section 6(a) required the Secretary immediately to promulgate as occupational safety or health standards all existing "established Federal Standards," including the 1000 $\mu g/m^3$ standard for cotton exposure.[26] These interim standards were intended to afford workers minimal protection until the adoption of permanent standards through OSHA's rulemaking proceedings.

On September 26, 1974, the Director of the National Institute of Occupational Safety and Health (NIOSH)[27] submitted to the Secretary of Labor a set of recommendations for regulating cotton dust. NIOSH recommended[28]

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[26] 29 U.S.C. § 655(a) (1976). *See also* 29 U.S.C. § 652(10) (1976). Congressional concern over delays in regulating cotton dust was manifest in the legislative history of the Occupational Safety and Health Act of 1970:

> "despite repeated warning over the years from other countries that their cotton workers suffered from lung disease, it is only within the past decade that we have recognized byssinosis as a distinct occupational disease among workers in American cotton mills." S. REP. No. 91-1282, 91st Cong., 2d Sess. 3 (1971), *reprinted in* LEGIS. HIST. 143.

[27] 29 U.S.C. § 671 (1976), establishes NIOSH within the Department of Health, Education, and Welfare as a national institute to "develop . . . recommended occupational safety and health standards." NIOSH's director is authorized, on his own initiative or at the request of the Secretary of Labor or the Secretary of Health, Education, and Welfare,

> to conduct such research and experimental programs as he determines are necessary for the development of criteria for new and improved occupational safety and health standards[.]

29 U.S.C. § 671(d)(1).

[28] Criteria Document: Recommendations for an Occupational Exposure Standard for Cotton Dust, J.A. 1-169.

that cotton dust exposure be "controlled to the lowest feasible limit which shall be less than 0.2 mg lint-free cotton dust/cu.m.," [29] or 200 $\mu g/m^3$.

Shortly thereafter, OSHA published an Advanced Notice of Proposed Rulemaking on cotton dust. OSHA requested interested parties to submit their views on the NIOSH recommendations and related issues concerning a proposed standard.[30] OSHA received comments from scientists, labor unions, industries, cotton growers, and governmental representatives. A proposed revision, published on December 28, 1976, called for an exposure limit of 200 $\mu g/m^3$ of cotton dust.[31] OSHA provided 90 days for interested parties to submit written comments.[32]

At the close of the comment period, OSHA conducted hearings in three cities for a total of 14 days.[33] The comments and exhibits received before the hearings, the written and oral testimony of the hearing participants, and post-hearing comments and briefs comprise the informal rulemaking record for the final cotton dust standard promulgated by the agency. This record exceeds 105,000 pages in length; it includes comments from 263 parties and testimony from 109 participants at the hear-

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[29] J.A. 1974. *See also* 41 Fed. Reg. 565000 (1976).

[30] 39 Fed. Reg. 44769 (1974). The Advance Notice requested interested parties to submit written data, views, and arguments concerning "whether a new standard . . . should be issued on the basis of the [NIOSH] criteria or any other information" and on the contents of a proposed standard. *Id.*

[31] 41 Fed. Reg. 56498 (1967), J.A. 171.

[32] *Id.* at 56515, J.A. at 188.

[33] The hearing was conducted in Washington, D.C. on April 5-8, May 2-6, and May 16-17; in Greenville, Mississippi, on April 12; and in Lubbock, Texas, on May 10-12, 1977.

ing. The Final Standard and its accompanying statement of reasons fill 68 pages of the Federal Register.[34]

C. *The OSHA Standard*

On the basis of the massive rulemaking record, OSHA promulgated the cotton standard in an effort to reduce the health risks to cotton workers.[35] Part of the standard sets "permissible exposure limits" (PELs) for each manufacturing operation and industry that exposes workers to cotton dust.[36] Thus, OSHA set (1) 200 micrograms

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[34] 43 Fed. Reg. 27350 (1978) (to be codified as 29 C.F.R. § 1910.1043(b)).

[35] *See* 43 Fed. Reg. 27394-418 (1978) (to be codified at 29 C.F.R. § 1910.1043). This is the first standard promulgated under § 6(b)(5) of the Act that does not involve a suspected carcinogen. Earlier standards were adopted for coke oven emissions, such as asbestos dust, *see* 29 C.F.R. § 1910.93a (1978).

Section 3(8) of the Act, 29 U.S.C. § 652(8) defines the term "occupational safety and health standard" to mean

> a standard which requires conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to provide safe or healthful employment and places of employment.

The Act requires employers to "comply with occupational safety and health standards promulgated" under the Act, 29 U.S.C. § 654(a)(2), in addition to their general duty to furnish employment and a place of employment "free from recognized hazards that are causing or are likely to cause death or serious physical harm . . . ." 29 U.S.C. § 654(a)(1).

[36] The proposed and final standards both set limits for exposure to cotton dust particles that are both lint-free and small enough to be breathed. These respirable particles can be measured in microns over a given time period. Relying on what it found to be "the most persuasive testimony" in the record, OSHA used a 15-micron cut-off point to separate

er cubic meter (200 $\mu g/m^3$) as the PEL for lint-free respirable cotton dust in yarn manufacturing; (2) 750 $\mu g/m^3$ for slashing and weaving operations in the cotton industry; and (3) 500 $\mu g/m^3$ for all other processes in the cotton industry and for all non-textile industries that expose workers to cotton dust.[37]

Implementation of the standard depends primarily on the adoption of engineering and work practice controls by employers. OSHA established a four-year implementation period during which employers are expected to achieve compliance. If an employer establishes that the required controls are infeasible, he can obtain an administrative variance from the standard,[38] but he must make respirators available to protect his employees until he achieves compliance.[39] The standard also requires em-

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respirable from non-respirable particles. 43 Fed. Reg. 27355 (1978). Once this cut-off size was determined, the rulemaking participants agreed that the verticle elutriator, a machine that screens airborne particles, is the best sampling device currently available. It separates particles larger than 15 microns from the remaining, "respirable" portion of dust. *Id.* at 27382-84. The verticle elutriator cotton sampling device eliminated from the sample all non-respirable particles, including cotton fly and lint fibers. *See* J.A. 129. In its final standard, OSHA designated the verticle elutriator "or a method of equivelent accuracy and precision" as the means for measuring dust levels, averaged over an eight-hour period. 43 Fed. Reg. 27395 (1978) (to be codified at 29 C.F.R. § 1910.43(c)). Also specified that the measuring devices "should operate at a flow rate of 7.4±0.2. liters per minute. *Id.* at 27398 (sampling equipment).

[37] *Id.* at 27395 (to be codified at 29 C.F.R. § 1910.1043(c)).

[38] *See* 43 Fed. Reg. 27395 (1978) (§ 1910.1043(e) of the standard); 29 U.S.C. §§ 655(b)(6)(A) (1976) (variance procedures). *See* text at note 235 *infra*.

[39] 43 Fed. Reg. 27396 (1978) (§ 1910.1043(f) of the standard); *id.* at 27386.

ployers to monitor employees' exposure to cotton dust, to provide medical surveillance and employee education, and to post warning signs about the health risks.

Before examining petitioners' objections, we consider the limits of our review.

II. Scope of Review

The Occupational Safety and Health Act of 1970 is one of a number of recent Congressional statutes that designates the stringent "substantial evidence" test for judicial review of notice-and-comment rulemaking.[40] The explicit language of the Act,[41] its legislative history,[42] and its application by the courts[43] confirm that regula-

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[40] *See* Federal Trade Commission Improvement Act of 1974, 15 U.S.C. § 57a(4)(3)(A) (1976); Consumer Product Safety Act, 15 U.S.C. § 2060(c) (1976); Toxic Substances Control Act, 15 U.S.C. § 2618(C)(1)(B)(i) (1976).

[41] The OSH Act, § 6(b)(5), 29 U.S.C. § 655(f) (1976), assigns the scope of review for any challenge to a standard issued under § 6 of the Act, 29 U.S.C. § 655:

> The determinations of the Secretary shall be conclusive if supported by substantial evidence in the record considered as a whole.

[42] H. Rep. No. 91-1765, 91st Cong., 2d Sess. 36 (1970) (Statement of the Managers on the Part of the House), *reprinted in* Legis. History at 1189. *See* Assoc. Indus. v. Dep't of Labor, 487 F.2d 342, 348-49 (2d Cir. 1973) (Friendly, J.) (discussing legislative history).

[43] In Industrial Union Dep't v. Hodgson, 499 F.2d 467 (D.C. Cir. 1974), this court rejected the claim that the substantial evidence test adopted in the Act should apply only to factual determinations. This view would leave policy judgments behind a challenged health and safety standard reviewable only under the arbitrary and capricious test. 499 F.2d at 473. Instead, this court concluded that under the Act, policy inferences along with factual determinations must not escape "exacting scrutiny" even though inferences cannot be strictly verified. *Id.* at 475. *See also* Assoc. Indus. v. Dep't of Labor, 487 F.2d 342, 349 (2d Cir. 1973).

tions promulgated under the Act are to be upheld on review if supported by "substantial evidence on the record considered as a whole." [44]

The substantial evidence test provides for more rigorous scrutiny than the usual "arbitrary and capricious" [45] test applicable to informal rulemaking.[46] Although Congress required this more rigorous judicial review, it nevertheless delegated unusually broad discretionary au-

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[44] 29 U.S.C. § 655(f) (1976). The requirement of substantial evidence "on the record considered as a whole" means that reviewing courts must take into account not just evidence that supports the agency's decision, but also countervailing evidence. Universal Camera Corp. v. NLRB, 340 U.S. 474, 481-82 (1951). Yet this requirement does not alter the court's fundamental duty to uphold the agency's "choice between two fairly conflicting views, even though the court would justifiably have made a different choice had the matter been before it *de novo*." *Id.* at 488.

[45] See Administrative Procedure Act, 5 U.S.C. § 706(2)(A) (1976). Until the last decade, this was the standard of review typically applied to informal rulemaking. *See* K. DAVIS, 1 ADMINISTRATIVE LAW TREATISE § 6.6 (1978). It remains as a basic standard of review, along with other criteria of legality and constitutionality, even when the substantial evidence test applies. *E.g.*, May Trucking Co. v. United States and ICC, 593 F.2d 1349, 1352 (D.C. Cir. 1979).

[46] In application, however, the lines between the two tests are far from clear. In Citizens to Preserve Overton Park, 401 U.S. 402, 415-16 (1971), the Supreme Court held that review of informal agency action must be "thorough, probing, in-depth" and "searching and careful"—even where the substantial evidence test does not apply. This court concluded in Greater Boston Telephone Corp. v. FCC, 444 F.2d 841, 852 (D.C. Cir. 1970), that even in reviewing agency adjudication, the essential requirement is reasoned decision making. *See generally* Assoc. Indus. v. Dep't of Labor, 487 F.2d 341, 349-50 (2d Cir. 1973) (convergence between "substantial evidence" and "arbitrary or capricious" criteria).

thority to regulate against possible harms.[47] We have already resolved this seeming anomaly in *Industrial Union Dep't v. Hodgson*, 499 F.2d 467 (D.C. Cir. 1974). There we concluded that the reviewing court's task under the Act is to provide a careful check on the agency's determinations without substituting its judgment for that of the agency.[48] Congress apparently created an "uneasy partnership" between the agency and the reviewing court[49] to check extravagant exercises of the agency's authority

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[47] The substantial evidence test was adopted in the Act apparently as a compromise when the House relinquished its advocacy of formal agency proceedings and adopted the Senate's informal rulemaking provision. *See* H. REP. No. 91-1765. 91st Cong., 2d Sess. 36 (1970), *reprinted in* LEGIS. HIST. at 1189. *See also* Industrial Union Dep't v. Hodgson, 499 F.2d at 473; Assoc. Indus. v. Dep't of Labor, 487 F.2d at 348-49 (discussing legislative history of scope of review provision).

[48] In *Industrial Union Dep't v. Hodgson*, this court construed the substantial evidence review in terms of the demands to be made by the reviewing court:

> What we are entitled to at all events is a careful identification by the Secretary, when his proposed standards are challenged, of the reasons why he chooses to follow one course rather than another. Where that choice purports to be based on the existence of certain determinable facts, the Secretary must, in form as well as substance, find those facts from evidence in the record. By the same token, when the Secretary is obliged to make policy judgments where no factual certainties exist or where facts alone do not provide the answer, he should so state and go on to identify the considerations he found persuasive.

499 F.2d at 475-76.

[49] Assoc. Indus. v. Dep't of Labor at 354. This partnership is uncomfortable for the courts chiefly because the record produced by informal rulemaking is not easily suited to close judicial scrutiny. *See* Florida Growers Ass'n v. Dep't of Labor, 489 F.2d 120, 129 (5th Cir. 1974). The record generally is a compendium of letters, studies, reports, and statements, untested by the adversary process. Reflecting the

to regulate risk.[50] Our role in this partnership is to ensure that the regulations resulted from a process of reasoned decisionmaking consistent with the agency's mandate from Congress.[51] By statute, this process must include notice to interested parties of issues presented in the proposed rule.[52] The agency must also provide opportunities for these parties to offer contrary evidence and arguments.[53]

OSHA adopted additional procedures to improve its decisionmaking process.[54] A qualified hearing examiner

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legislative nature of informal rulemaking, the record often does not even display the full range of considerations before the agency when the decision was made. Pedersen, *Formal Records and Informal Rulemaking*, 85 YALE L.J. 38, 62 (1975). Furthermore, the decision necessarily rests on policy considerations authorized by the agency's mandate. Judicial review of such considerations cannot be identical to review of factual determinations.

[50] Congress wanted the Secretary to protect workers not only against known harms, but also against risks of harms not entirely understood. *See, e.g.*, S. REP. No. 91-1282, 91st Cong., 2d Sess. 4 (1970), *reprinted in* LEGIS. HIST. at 144 (discussing need to regulate organophosphates and chlorinated hydrocarbons).

[51] Universal Camera v. NLRB, *supra* at 488; Ethyl Corp. v. EPA, 541 F.2d 1, 34 (D.C. Cir.), *cert. denied*, 426 U.S. 941 (1976).

[52] 29 U.S.C. §§ 655(b) (2), (3) (1976).

[53] *Id.*

[54] The OSH Act requires the Secretary to follow these procedures in promulgating health and safety standards under § 655 of the Act:

1) publication of the proposed rule in the Federal Register, § 655(b) (2);

[Continued]

must preside at oral hearings on proposed standards. A verbatim transcript of the hearing is required, and cross-examination is permitted. These procedures, which were followed in this case, transform OSHA's action into "hybrid" rulemaking,[55] and produce a record more susceptible to rigorous judicial review than the more usual informal rulemaking record.[56]

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[54] [Continued]

2) opportunity for interested parties to submit "written data or comments" within thirty days after publication of the proposed rule, § 655(b)(2);

3) opportunity for interested parties to submit "written objections to the proposed rule . . . and request[] a public hearing on such objections," § 655(b)(3);

4) publication in the Federal Register of time and place for hearing scheduled on objections to proposed standard, § 655(b)(3); and

5) promulgation of final rule, or decision not to issue one, within sixty days after period permitted for written comments, or within sixty days after completion of hearing, § 655(b)(4).

These provisions add to the minimal procedures required by the APA, 5 U.S.C. § 553 (1976).

The agency also requires that all relevant information, including submissions and testimony, must be considered in formulating the final standard. 29 C.F.R. § 1911.18(a)(1) (1978). The statement of basis and purpose for the final standard must describe "the significant issues which have been faced, and . . . the rationale for their solution." 29 C.F.R. § 1911.18(b) (1978).

[55] *See* K. DAVIS, 1 ADMINISTRATIVE LAW TREATISE, 453 (1978).

[56] In describing the additional procedures, the agency noted a congressional expectation that the rulemaking would be on the basis of a record "to which a substantial evidence test, where pertinent, may be applied." 29 C.F.R. § 1911.15(a) (1978).

The tasks of this reviewing court are thus to ensure that the agency has (1) acted within the scope of its authority;[57] (2) followed the procedures required by statute and by its own regulations;[58] (3) explicated the bases for its decision; (4) adduced substantial evidence in the record to support its determinations.[59]

The meaning of "substantial evidence" in this context is problematic. Factual proof about particular health risks may not be substantial in the traditional sense simply because the medical and scientific communities do not yet completely understand the nature of threatening diseases. To protect workers from material health impairments, OSHA must rely on predictions of possible future events and extrapolations from limited data. It may have to fill gaps in knowledge with policy considerations. Congress recognized this problem by authorizing the agency to promulgate rules on the basis of the "best available evidence."[60] OSHA's mandate necessarily requires it to act—even if information is incomplete—

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[57] Citizens to Preserve Overton Park v. Volpe, 401 U.S. 402, 415 (1971); City of Chicago v. FPC, 458 F.2d 731, 745 (D.C. Cir. 1971); Automotive Parts & Accessories Ass'n v. Boyd, 407 F.2d 330, 343 (D.C. Cir. 1968); 5 U.S.C. § 706(a)(C) (1976).

[58] Citizens to Preserve Overton Park v. Volpe, 401 U.S. 402, 417 (1971); Friends of the Earth v. United States Atomic Energy Comm'n, 485 F.2d 1031, 1033 (D.C. Cir. 1973); 5 U.S.C. § 706(2)(D) (1976).

[59] *See* note 40 *supra*. We have also described these three elements as review of (1) the agency's interpretation of its authorizing statute; (2) procedural integrity; and (3) the substantive basis for the agency's decision. Weyerhaeuser Co. v. Costle, 590 F.2d 1011, 1024-28 (D.C. Cir. 1978).

[60] 29 U.S.C. § 655(b)(5) (1976). The best available evidence in an area of changing technology and incomplete scientific data may leave gaps in knowledge that require policy judgments in constructing the health and safety standard. In

when the best available evidence indicates a serious threat to the health of workers.[61] Thus, a court entrusted with the rigorous "substantial evidence" review must examine not only OSHA's factual support, but also the "judgment calls" and reasoning that contribute to its final decision.[62] Otherwise, an agency's claim of ignorance would clothe it with unreviewable discretion.

Therefore, the reviewing court must examine both factual evidence and the agency's policy considerations set forth in the record. To facilitate this review of the record, the agency must pinpoint the factual evidence and the policy considerations upon which it relied.[63]. This requires explication of the assumptions underlying predictions or extrapolations,[64] and of the basis for its

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recent statutes Congress has defined "evidence" to mean "any matter in the rulemaking record." *E.g.*, Toxic Substances Control Act, 15 U.S.C. § 2618(c)(1)(B) (1976).

[61] 29 U.S.C. § 655(b)(5) (1976). A suit was filed in 1975 charging unlawful delay in modification of the then-existing standard. Amalgamated Clothing & Textile Workers Union, et al. v. Secretary of Labor, No. 75-2157 (D.C., filed Dec. 24, 1975).

[62] 499 F.2d at 475; 487 F.2d at 348.

[63] *See* SEC v. Chenery Corp., 318 U.S. 80, 87 (1943).

[64] With regard to environmental rulemaking, this court held that

> Where a statute is precautionary in nature, the evidence difficult to come by, uncertain, or conflicting because it is on the frontiers of scientific knowledge, the regulations designed to protect the public health, and the decision that of an expert administrator, we will not demand rigorous step-by-step proof of cause and effect. Such proof may be impossible to obtain if the precautionary purpose of the statute is to be served. . . . The Administrator may apply his expertise to draw conclusion from suspected, but not completely substantiated, relationships

esolution of conflicts and ambiguities.[65] In enforcing hese requirements, the court does not reach out to resolve controversies over technical data.[66] Instead, it seeks to ensure public accountability. Explicit explanation for the basis of the agency's decision not only facilitates proper judicial review but also provides the opportunity for effective peer review, legislative oversight, and public

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> between facts, from trends among facts, from probative preliminary data not yet certifiable as 'fact,' and the like.

Ethyl Corp. v. EPA, 541 F.2d 1, 28 (D.C. Cir. 1976) (citations omitted). *See* Amoco Oil Co. v. EPA, 501 F.2d 722, 740-41 (D.C. Cir. 1974) (reasons and explanations, but not findings, required for predictions used in risk regulation).

[65] [W]hen the Secretary is obliged to make policy judgments where no factual certainties exist or where facts alone do not provide the answer, he should so state and go on to identify the considerations he found persuasive.

499 F.2d at 476.

[66] *See* Ethyl Corp. v. EPA, 541 F.2d 1, 67 (D.C. Cir. 1976) (Bazelon, C.J., and McGowan, J., concurring); Internat'l Harvester Co. v. Ruckelshaus, 478 F.2d 615, 652 (D.C. Cir. 1973) (Bazelon, C.J., concurring in result). From their stance outside of both scientific and political debates, courts can help to ensure that decisionmakers articulate the basis for their decisions. But once courts step beyond that role and endeavor to judge the merits of competing expert views, they leave the terrain they know. In so doing, the judiciary may mislead the public into believing it provides an expert check on decisions that in fact it does not fully comprehend.

Thus, a court applying the substantial evidence test to a numerical standard considers "whether the agency's numbers are within a 'zone of reasonableness,' not whether its numbers are precisely right." Hercules, Inc. v. EPA, 598 F.2d 91, 107 (D.C. Cir. 1978). Similarly, the possibility of drawing two inconsistent conclusions from the evidence does not prevent an administrative agency's finding from being supported by substantial evidence. Environmental Defense Fund v. EPA, 510 F.2d 1292, 1298 (D.C. Cir. 1975); *accord* Bayside Enterprises, Inc. v. NLRB, 429 U.S. 248, 302 (1976).

education. This requirement is in the best interest of everyone, including the decisionmakers themselves. If the decisionmaking process is open and candid, it will inspire more confidence in those who are affected. Further, by opening the process to public scrutiny and criticism, we reduce the risk that important information will be overlooked or ignored. Instructed by these ends, this court on review will "combine supervision with restraint." [67]

III. Challenges By the Textile Industry

The textile industry petitioners acknowledge that textile workers who are exposed to cotton dust may risk contracting byssinosis.[68] Their challenge focuses on the regulatory approach OSHA has chosen to reduce that risk. Specifically, they ask us to find that OSHA's regulatory approach is not "reasonably necessary" to protect textile workers from the admitted danger posed by cotton dust.[69] Further, they ask us to find that approach technologically and economically infeasible.[70]

A. *Challenge to the Regulatory Approach*

OSHA chose a "dust control strategy" that requires engineering and work practice controls to limit worker exposure to the "lowest feasible [cotton] dust levels" within four years.[71]

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[67] Public Serv. Comm'n v. FPC, 511 F.2d 338, 355 (D.C. Cir. 1975).

[68] *See, e.g.*, Joint Brief Textile Petitioners at 2-3; 8-9 [hereinafter cited as Textile Brief] ("[t]he development of byssinosis has been associated with the inhalation of an unknown element in the dust generated by the handling or processing of cotton"); *id.* at 18 (referring to "the slowly progressive health hazard presented by exposure to 'cototon dust' ").

[69] Textile Brief at 54-65.

[70] *Id.* at 18-20, 29-34, 37-54.

[71] *See* text at notes 37-39.

The textile industry rejects OSHA's approach as unnecessarily expensive. The industry contends that workers can be fully protected from "'*material impairment* of [their] health or functional capacity'" by a higher permissible exposure level coupled with a medical surveillance program.[72] The industry's alternative would permit an exposure level of 500 $\mu g/m^3$ in all cotton manufacturing operations except weaving, for which a PEL of 1000 $\mu g/m^3$ is proposed. This alternative would also require workers to wear respirators or accept transfers to lower exposure work areas if medical surveillance shows that they are suffering from byssinosis symptoms "which, with years of continued exposure, could lead to [material health] impairment."[73]

The textile industry petitioners claim that OSHA failed to seriously consider their alternative or to provide adequate reasons for rejecting it. The industry also claims that the regulatory approach adopted by OSHA is not permitted by the Act.[74] We disagree with both claims.

First, OSHA gave serious attention to the medical studies conducted by the textile industry and proffered to support the industry's alternative.[75] These studies pur-

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[72] *Id.* at 57 (emphasis in original); *id.* at 21.

[73] *Id.* at 21-22. The industry claims that its approach will provide protection comparable to OSHA's strategy in that neither completely eliminates the occurance of early byssinosis symptoms. *Id.* at 16-17.

[74] *Id.* at 54-64.

[75] The industry relies on the following studies: (1) Burlington Industries, Inc., study of 12,519 workers from 1970-1976 (Joint Appendix (J.A.) 2035; (2) West Point-Pepperell, Inc. study of 9,181 workers in 1973 (J.A. 1987, 2005); (3) study by Dr. W.K.C. Morgan of 720 workers (J.A. 2008); (4) study by Dr. Hans Weill, an OSHA witness, with complete data on 418 workers (J.A. 1235, 1240); (5) study by Cone Mills Corporation of 6,631 workers (J.A. 2012). These studies are discussed at length in OSHA's statement of reasons. *See* 43 Fed. Reg. 27355-57 (1978).

port to show that medical surveillance programs at various textile plants have already afforded workers a level of protection comparable to that offered by OSHA's approach. The record shows that OSHA specifically addressed and scrutinized these studies, and concluded that their validity had largely been discredited.[76] OSHA's judgment on

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[76] *See generally*, 43 Fed. Reg. 27355-57. OSHA found the industry studies deficient on many grounds. First, the prevalence of byssinosis reported at the studied mills tended to be low, but these mills had experienced dust reduction *prior to* implementation of medical surveillance. Consequently, the mills studies by the textile industry lacked a necessary precondition—a dust level of at least 500 $\mu g/m^3$—validly to test the industry's contention that their proposal would be as effective as OSHA's lower PELs in reducing the prevalence of byssinosis.

OSHA also identified substantial, unexplained differences between the percentage of workers who reported subjective byssinosis symptoms and the percentage of those showing pulmonary function decrements indicative of the disease. The textile industry refers to workers' subjective health reports but not to the objective, pulmonary function measurements. The Union petitioners note that workers sometimes falsely deny byssinosis symptoms for fear of losing their jobs if their employer learns that their health is impaired. AFL-CIO, American Textile Manufacturers Institute, Inc., *et al.*, Petitioners Reply Brief and Brief in Intervention at 42 n.55 [hereinafter Union Reply Brief].

OSHA also criticized the industry studies on a number of other grounds. 43 Fed. Reg. 27356-57. First, none of the studies had been subjected to peer review through publication in scientific journals. None of them produced dose-response data, that is, data charting medical responses to different dust levels. The populations studied may not be representative of the entire affected population. Finally, the validity of the studies could not be verified because the textile industry declined to furnish the underlying data, and in some cases, failed to produce the authors of the studies for cross-examination at the hearing. Consequently, OSHA concluded that these studies provided insufficient basis for the regulation.

this issue is sufficiently supported on this basis.[77]

Besides this careful treatment of the medical surveillance proposal, OSHA rejected the industry's proposed reliance on job transfers and respirators to protect workers suffering from acute symptoms of byssinosis on the basis of testimony in the record and express policy considerations.[78] The industry was unable to show that job transfers would be available in sufficient number to respond to the likely prevalence of byssinosis in plants with dust levels at the 500 $\mu g/m^3$ proposed by the industry.[79] Further, the agency found uncontradicted testimony in the record that respirators can cause severe physical discomfort and create safety problems of their own.[80] OSHA concluded that the industry's proposal in-

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[77] Our task is not to resolve the controversy over the studies, but to determine if the agency received and fairly responded to challenges. It did so here in its consideration of the industry's studies. Its explicit identification of flaws in the studies can, *inter alia*, alert future participants to the quality of research it seeks as a basis for its regulations.

[78] 43 Fed. Reg. 27384 (1978).

[79] OSHA, relying on dose-response data submitted by Dr. Merchant, found that 25% of the workers exposed to a 500 $\mu g/m^3$ PEL would develop byssinosis. At this prevalence rate, it is doubtful that all of the affected workers could be moved to a low exposure area. *See, e.g.*, Testimony of Dr. Imbus, Medical Director, Burlington Industries (J.A. 3379-80) noting that 10% was the maximum number of workers who could be reassigned through a medical surveillance and job transfer approach).

[80] OSHA carefully explained why it rejected "a control strategy involving principal reliance on respiratory protection[] to reduce the cost of compliance":

> [R]espirators have many disadvantages which preclude primary reliance or co-reliance on respiratory protection on an equal basis with engineering and work practice controls. The many difficulties . . . were enumerated at

appropriately placed the burden of compliance on the employees.[81] On this express policy ground, and on the basis of the evidence in the record, OSHA reasonably rejected these elements in the industry alternative.

Finally, the textile industry argues that the agency's effort to reduce workers' cotton dust exposure to the lowest feasible level is not "reasonably necessary or appropriate." [82] This argument rests on the claim that the agency need not guard against the acute but reversible symptoms of byssinosis because they do not themselves constitute a "material impairment of health." [83] We find

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> the hearing . . . because of difficulties in face fit, it is difficult to know whether the respirator actually provides adequate protection; respirators, by interfering with vision, hearing, and mobility, can cause safety problems; some employees cannot wear respirators because of breathing difficulties.

43 Fed. Reg. 27384 (1978).

[81] *Id.* ("it is not appropriate to place the burden of compliance principally on the employee, as would be the case if respiratory protection were the principal means of reducing employee exposure.").

[82] Textile Brief at 21, 55. "Reasonably necessary or appropriate" is language from the statutory definition of an "occupational safety and health standard." *See* § 652(8) (defining "occupational safety and health standard" as requiring conditions or practices "reasonably necessary or appropriate to provide safe or healthful employment and places of employment"). Apparently, the thrust of the textile industry's argument on this point is not that OSHA lacks the power to promulgate a standard that reduces worker exposure to the lowest feasible levels. Rather, the industry argues that OSHA inadequately explained why "it chose to apply its full range of powers" instead of accepting the industry's less stringent alternative. *Id.* at 63-64.

[83] *See id.* at 57-59. The Act does not itself define "material impairment." Although testimony at the rulemaking hearing described the acute symptoms of byssinosis as "a serious health

that this claim and its attendant argument must fall in the face of the agency's evidence and reasons.

The agency adopted a "dust control strategy" after finding conclusive evidence of a causal relation between exposure to cotton dust and the contraction of respiratory diseases, such as byssinosis. The agency acknowledged gaps in medical understanding of the specific causal relationship between cotton dust and disease.[84] Nonetheless, the agency's mandate requires it to protect workers' health even before the resolution of all medical and scientific uncertainties about the particular health risk.[85] Further, OSHA heard several witnesses conclude that at present," there is no basis for any programs of prevention and control of byssinosis other than those based on prevention of exposure to respirable cotton dust." [86] Virtually without exception, key textile industry witnesses along with public health experts rejected medical surveillance as an alternative to dust reduction.[87] Accordingly,

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hazard," Hearing Transcript at 168 (testimony of Dr. Bouhuys), we do not here need to decide whether these symptoms constitute "material impairment" for the purposes of the Act. Instead, we find adequate support in the record for the agency's choice of the dust control strategy effectively to protect workers from byssinosis, which is conceded by all to cause material impairment in its chronic stage.

[84] *See* note 16 *supra.*

[85] *See* H. Rep. 91-1291, 91st Cong., 2d Sess. at 18 (1970), *reprinted in* LEGIS. HIST. at 848 (OSHA not to "be paralyzed by debate surrounding diverse medical opinion"). *See also* Soc'y of Plastics v. OSHA, 509 F.2d 1301, 1308 (2d Cir. 1975), *cert. denied*, 421 U.S. 992 (1975).

[86] 43 Fed. Reg. 27355 (1978).

[87] The textile industry's leading witness, Dr. Imbus of Burlington Industries, acknowledged that "[m]edical surveillance programs are not a substitute for diligent efforts to control dust." J.A. 396.

[Continued]

the agency adduced considerable evidence to support its dust control strategy.

The agency's approach, which is similar to its strategy in regulating asbestos,[88] is authorized by the primary purpose and by the special mandate of the Act. Section 2(b) sets out the Act's broad protective purpose: "to assure so far as possible every working man and woman in the Nation safe and healthful working conditions." Toward this end, section 6(b)(5) authorizes OSHA to set permanent standards for occupational exposure to "toxic materials or harmful physical agents" at the level

> which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure to the hazard dealt with by such standard for the period of his working life.[89]

Contrary to the industry's view, this mandate does not restrain the agency from acting to prevent irreversible health damage until workers actually suffer the early symptoms of byssinosis. Instead it is a mandate to reduce

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[87] [Continued]

The need for a dust control strategy was a constant theme of expert testimony. Drs. Merchant and Bouhuys, for example, both recommended PELs well below the 500 $\mu g/m^3$ level proposed by the textile industry. At the hearing, Dr. Bouhuys and NIOSH recommended a 200 $\mu g/m^3$ PEL. J.A. 1233, 1448. Dr. Merchant recommended a PEL of 100 $\mu g/m^3$. J.A. 369. Even Dr. Weill, who appeared on behalf of the textile industry, declined to endorse the industry's proposed PEL. Instead he recommended that the PEL be set somewhere between 200 $\mu g/m^3$ and 500 $\mu g/m^3$. J.A. 1237.

[88] *See* 29 C.F.R. 1910.93a (1978); Industrial Union Dep't v. Hodgson, 499 F.2d 467, 478-81 (D.C. Cir. 1974) (discussing asbestos standard).

[89] 29 U.S.C. § 655(b)(5) (1976).

the risk of that irreversible damage—especially for those workers who have regular exposure to the causal agent, cotton dust. In the present case, OSHA adequately documented the risk of such damage attributable to continued exposure to cotton dust. Medical experts testified on the record that the early, acute symptoms of byssinosis weaken the worker's pulmonary system and increase his susceptibility to the adverse effects of subsequent cotton dust exposure.[90] We therefore uphold OSHA's decision to reduce the prevalence of chronic byssinosis through regulations stringent enough to reduce even the occurence of the reversible acute stage of the disease.

B. *Feasibility of the Standard*

All parties acknowledge that OSHA must evaluate technological and economic feasibility in setting permanent standards under section 6(b)(5) of the Act. These considerations set constraints on the agency's mandate to assure employees "the highest degree of health and safety."[91] In light of petitioners' claims, we must examine the record to ensure that OSHA has not exceeded its mandate by neglecting these constraints.

We are assisted here by this court's interpretation of the feasibility requirement in *Industrial Union Dep't, AFL-CIO v. Hodgson.* In that case, we concluded that

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[90] *E.g.*, J.A. 1218.

[91] § 6(b)(5); 29 U.S.C. § 655(b)(5) (1975). The Secretary is to promulgate a health and safety standard "which most adequately assures, *to the extent feasible*, on the best available evidence, that no employee will suffer material impairment or health or function capacity. . . . In addition to the attainment of the highest degree of health and safety protection for the employee, other considerations shall be the latest available scientific data in the field, *the feasibility of* the standards, and experience gained under this and other health and safety laws." (emphasis added).

the feasibility requirement reflects Congress' recognition that employees would not be protected if their employers were put out of business.[92] This possibility is all too real if the agency inflexibility requires protective devices unavailable under existing technology or otherwise makes financial viability impossible.[93] At the same time, we concluded, standards do not become infeasible simply because they may impose substantial costs on an industry, force the development of new technology, or even force some employers out of business.[94] Otherwise the Act's commitment to protect workers might be forever frustrated.

In this case, the textile industry petitioners contend that the record does not support OSHA's findings of technological and economic feasibility. First, they argue that the standard is technologically infeasible for the spinning through weaving stages of textile manufacturing.[95] Further, they argue that the record does not sup-

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[92] 499 F.2d 467, 477-78 (D.C. Cir. 1974).

[93] *Id.*

[94] "It would appear to be consistent with the purposes of the Act to envisage the economic demise of an employer who has lagged behind the rest of the industry in protecting the health and safety of employees and is consequently financially unable to comply with new standards as quickly as other employers." *Id.* at 478.

[95] Textile Brief at 20, 28-34. According to the industry, the production of fabric from cotton involves twelve distinct manufacturing operations, falling into three general stages. *Id.* at 7.

During the first stage, raw cotton is cleaned and prepared for spinning into yarn. This first stage involves opening, picking, carding, drawing, and roving the cotton. The second stage transforms the prepared cotton into yarn and packages it for subsequent processing. The principal operation in this stage is spinning, during which the prepared cotton slivers are elongated. The next operations in this stage consolidate units of spun yarn and prepares them for weaving by twisting, winding, spooling, and warping. The third stage of oper-

port the agency's finding that the standard is economically feasible. In addition, they argue that "OSHA failed to satisfy its obligation seriously to weigh even its grossly understated costs against the benefits sought to be secured by the Standard." [96]

Our review of these challenges is not designed to resolve the technical and economic debates. Our duty is simply to determine from close scrutiny of the entire record whether the feasibility of the standard is adequately supported by data and policy considerations. In addition, the agency must have considered and responded to serious challenges to the claim of feasibility. On both counts, we find that OSHA has performed its task adequately.

1. *Technological feasibility*

The textile industry does not argue that the exposure level set for the intial stages of textile manufacturing is technologically infeasible.[97] Its attack is limited to the feasibility of the level set for the later stages of spinning through weaving,[98] and to the four-year deadline for

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ations involves slashing and weaving. Slashing adds sizing to the yarn; weaving then interlaces two sets of yarn to produce a woven fabric. Under the cotton dust standard, the first two stages are classified together as "yarn manufacturing." *Id.* at 7-8.

[96] *Id.* at 21. The Unions also challenge the standard under the feasibility requirement, but unlike the textile industry petitioners, they argue that the exposure level set by the agency is not the lowest one feasible. We consider this challenge in note 150 *infra*.

[97] *Id.* at 25 ("general principles of dust control . . . are expected generally to yield compliance in the operations from *opening through roving*" stage.

[98] *Id.* at 24-35 (challenging technological feasibility of 200 $\mu g/m^3$ set for spinning through warping and 750 $\mu g/m^3$ set for slashing and weaving).

compliance.[99]

Judging the technological feasibility of a particular agency goal is beyond the expertise of the judiciary especially where the assessment involves predictions of technological changes.

Instead, our task on review is to find whether the agency sufficiently supported its feasibility determination with material in the record. Here, the agency's position is supported with evidence that existing dust control techniques can bring about compliance in the textile industry.[100]

First, OSHA points to evidence in the record that many employers already are in compliance with the 200 $\mu g/m^3$ PEL set for spinning through warping operations. This finding at least in part refutes the industry's charge that on technological grounds it cannot meet the required exposed level for these operations. Notably, three-fourths of the spinning operations described in the industry's own study had dust levels below the 200 $\mu g/m^3$ level and others were very close to voluntary compliance.[101]

The textile industry does not contend that the looms or frames not yet in compliance in any way differ from those already complying with the new PEL. Rather, the industry asserts that the noncomplying mills run dustier

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[99] *Id.* at 34-37. *See* Part V *infra* for our consideration of this claim.

[100] These measures include improving general ventilation, and requiring better maintenance of equipment. OSHA also recommended more thorough cleaning of the cotton in the opening and cleaning processes, and better dust control in the opening through roving stages or isolation of these operations. *See* 43 Fed. Reg. 27363-65 (1978). *See also* J.A. 3607-08, 1145 (improving general ventilation); J.A. 80 (equipment maintenance); J.A. 1886 (cleaning of cotton); J.A. 2445 (dust control); and J.A. 551 (isolation of certain processes.

[101] *See, e.g.*, J.A. 3490-3560; 2008-2011. *See generally* 43 Fed. Reg. 27362-68 (1978).

cotton. This contention, as OSHA answers, is belied by the record, for the requisite PEL has been met in spinning operations running 100% coarse cotton, which is the dustiest variety.[102]

There is also evidence that some mills have achieved low dust levels in the twisting, winding, spooling, and warping operations.[103] OSHA admits that these operations have been studied less than spinning, apparently because these operations generate very little cotton dust.[104] The agency nevertheless obtained evidence that existing dust control principles can be adapted to these operations as the need arises.[105]

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[102] J.A. 3532, 3538-40, 3544.

[103] J.A. 792-93, 1887; 43 Fed. Reg. 27367 (1978).

[104] *See* 43 Fed. Reg. at 27367 ("Levels in [winding, spooling, twisting, and warping] are currently very low and are not expected to present a compliance problem") (citations to the record omitted).

[105] *See, e.g.*, J.A. 2240-41. Thus OSHA acknowledged that the

> industry has had less experience with specific controls past roving. OSHA recognizes these difficulties and further recognizes that increased effort may be necessary in some instances to achieve compliance with the exposure limits prescribed for the textile operations. Yet, the evidence in the record demonstrates the feasibility of adopting dust control principles, proven successful in other operations, to new stages of the process.

32 Fed. Reg. 27362 (1978). The agency also concluded generally that "inherent operational difficulties found in some operations may require increased effort to reduce dust levels to 200 $\mu g/m^3$; however, OSHA agrees with RTI's assessments and concludes that the vast majority of workplaces will be able to comply with little difficulty." *Id.* at 27367. ("RTI" is the Research Triangle Institute which completed the "Technological Feasibility Assessment and Final Inflationary Impact Statement" for OSHA. J.A. 457

Similarly, the PEL set for slashing and weaving operations apears reasonable in light of the record. The industry's own chief witness estimated that 72% of the weaving operations met the requirement of 750 $\mu g/m^3$ when studied.[106] OSHA also cited a study in the record that identified three basic approaches to permit compliance by the remaining mills in these operations: (1) isolating the weaving rooms; (2) separating room ventilation systems; and (3) installing local exhaust ventilation equipment.[107]

Thus, for each operation of textile manufacturing, the agency established evidence of present compliance and existing control measures capable of increasing compliance. The agency therefore concluded that a

> combination of specific control measures . . . the adoption and modification of general dust controls, and further utilization of technological developments . . . already underway, should achieve compliance for the textile industry.[108]

The industry objects that OSHA drew unwarranted generalizations from dust measurements at small numbers of plants[109] and from expert testimony on general

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[106] Testimony of Hovan Hocutt, J.A. 3929-3920. Other evidence submitted by the industry suggests that compliance may be even more widespread for the weaving operations. Of 32 weaving operations studied, 28 were below 750 $\mu g/m^3$, and no reading was greater than 870 $\mu g/m^3$. J.A. 3490-3560. And these measurements were taken before recent improvements in dust control. *See* J.A. 3490-3560.

[107] 43 Fed. Reg. 27367 (1978) (summarizing Research Triangle Institute (RTI) Technological Feasibility Assessment and Final Inflationary Impact Statement, IV-14-16 (1976), J.A. 1, 550-552).

[108] 43 Fed. Reg. 27362.

[109] OSHA's brief merely cites several instances where dust levels in [the twisting, winding, spooling and warping]

principles of dust control.[110] We agree that OSHA might have improved the quality of the record with more extensive studies at different mills and over different periods of time.[111] Further study, however, would have added substantial additional cost and delay to an already costly and prolonged rulemaking proceeding.[112] Rather than directing the agency to wait for the best evidence, the OSH Act requires the agency to develop standards based upon "the best *available* evidence."[113] This court will not require further survey research from the agency especially where it has made an informed decision to rely

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> operations are at or below 0.5 mg/m³ or 0.2 mg/m³. None of these references prove, or even suggest, that the required 0.2 mg/m³ either exists on a constant basis or is being achieved by the application of dust control equipment.

Textile Reply Br. at 8.

[110] Textile Br. at 29.

[111] It also would have been helpful to the court if OSHA had more fully delineated the methodological assumptions underlying some of the studies on which it relied. A more logical and systematic explanation of the inferences drawn from studies would have facilitated our review. Nonetheless, the agency did adequately explain the factual and policy considerations informing its judgments.

[112] The Unions and the North Carolina Public Interest Research Group filed suit in 1975 to prevent what they contended was unlawful delay in promulgation of the standard. Amalgamated Clothing & Textile Workers Union, et al. v. Secretary of Labor, No. 75-2157 (D.C.D.C.). The district court judge repeatedly admonished the government to promulgate the standard without improper delay. *See* Transcript of Proceedings on June 6, 1978. Secretary of Labor Marshall makes reference to this suit in his May 24, 1978 "Memorandum . . . to President Carter Urging Issuance of Cotton Dust Standard." 8 BNA Occupational Safety and Health Reporter 54-55 (June 8, 1978).

[113] Section 6(b)(5), 29 U.S.C. § 655(b)(5) (1976).

on other credible sources of information, such as the extensive expert testimony, written comment and briefs, and research studies used here.[114]

Indeed, other circuits have upheld permanent health standards supported by less extensive and persuasive evidence than that present here. Those courts have upheld similar OSHA standards that require compliance with PELs that had never before been attained,[115] or that had been reached only at the "newest, cleanest" plants.[116] Here, OSHA has shown that much of the textile industry already has demonstrated its ability to comply with the cotton dust standard. It also points to evidence in the record that little, if any, technological innovation will be necessary for compliance to be reached in the entire in-

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[114] In its "Proposed Standards and Notice of Hearing," OSHA said that it

> recognizes that many of the matters considered in this proposal are controversial and that gaps exist in the available scientific evidence. OSHA believes, however, that in this case we are dealing with an agent or agents that are extremely harmful to man. The existence of unanswered questions cannot be permitted to delay the process of proposing a standard for protecting workers exposed to cotton dust, as tens of thousands of workers are believed to suffer from the effects of exposure. OSHA hopes that the public participation which is invited will help to fill whatever gaps exist.

41 Fed. Reg. 56508 (1976).

[115] Society of the Plastics Industry, Inc. v. OSHA, 509, F.2d 1301 (2d Cir.), *cert. denied*, 421 U.S. 992 (1975).

[116] American Iron and Steel Inst. v. OSHA, 577 F.2d 825, 833, 834 (3d Cir. 1978), *petitions for cert. pending*, Nos. 78-918, 78-919 (upholding OSHA's standards for coke oven emissions on the basis of reductions in emission levels at some plants; concluding that the industry "could with some self-confidence and determination develop 'their own technological potentialities' and achieve a variety of improvements.").

dustry.[117] Thus, the agency's finding of technological feasibility here is even more persuasive than findings affirmed in other cases that require the creation of new technology.

In sum, the agency fairly considered and took account of objections to its assessment of technological feasibility for the textile industry.[118] The agency linked its determination to evidence and policy considerations in the record. We support its judgment.

2. *Economic Feasibility*

The petitioners concede that OSHA's estimate of $550 million in capital costs would be economically feasible for the textile industry, but they claim that OSHA's estimate grossly understates the actual costs the industry will incur if the standard goes into effect. To evaluate this claim, we must first consider the accuracy of OSHA's cost estimate and then review its feasibility determination.

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[117] OSHA noted one instance in which technological innovation would assist compliance with the cotton dust standard. Conversion of mills from traditional "ring" spinning to "open end" spinning would reduce the dust exposure to workers, yet, as OSHA acknowledged, ring spinning is not yet practical for all textile mills. 43 Fed. Reg. 27367 (1978). The agency concluded that "present general principles of ventilation control coupled with proven and applied control strategies" would be sufficient to bring the spinning operations into compliance, and technological innovation would simply be encouraged. *Id.*

[118] OSHA stated that it found unpersuasive the testimony of the textile industry's chief expert witness, Hovan Hocutt. The agency observed that Hocutt's experience derived primarily from his knowledge of the opening through roving operations, while the standards governing the operations of spinning through weaving gave rise to the most serious challenges. Further, the agency concluded that Hocutt "seemed to view each process in isolation and completely and consistently ignored the possibilities of dust control [other than through local exhaust equipment.]" OSHA Br. at 106, n.84.

a. Accuracy of cost estimates

OSHA derived its cost estimates from two principal sources: the Research Triangle Institute (RTI) estimates for the entire textile process [119] and industry estimates for part of the textile process.[120] OSHA tried to account for the divergence between the estimates from these two sources by exploring the assumptions each employed.[121] After examination, the agency decided that both sets of estimates are overstatements, and chose to rely on what it regarded the best portions of each estimate.[122]

All parties agreed that the largest cost imposed by the standard is the capital cost of engineering controls. OSHA found the RTI capital cost figures to be overstated on several bases.[123] OSHA concluded that RTI inappro-

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[119] Research Triangle Institute, Cotton Dust: Technological Feasibility Assessment and Final Inflationary Impact Statement VI- V-129 & Appendices B, C & D (1976) (prepared for OSHA) (reprinted at J.A. Vol I at 619-750, 801-995 & Appendices B, C & D)). *See also* "Technological Feasibility and Economic Impact of Regulations for Cotton Dust: Testimony to be Presented by The Research Triangle Institute at Public Hearing," (1977) (reprinted at J.A. Vol. II, 1320-80.

[120] *See* Statement of Hovan Hocutt, Senior Vice President of Engineering Pneumafil Corporation, J.A. Vol. II, 2228-47; Statement of Arthur Thomas, Senior Vice President, The Bahnson Company, J.A. Vol. II at 2248-57.

[121] *See* 43 Fed. Reg. 27370-27380.

[122] OSHA's estimate of total compliance costs for the textile industry is based on the industry estimates for capital costs and annualized costs, and the RTI estimates for costs of medical surveillance and other non-capital expenditures. 43 Fed. Reg. 27373 (1978); *id.* at 27380 (Table 3).

[123] OSHA also criticized the RTI estimates of annualized capital costs for failing to take account of the investment tax credit. *Id.* at 27371. The estimates also assumed a high interest rate, but OSHA found this an acceptable reflection of the industry's external financing situation. Thus, OSHA concluded that the RTI estimates of annualized capital costs were calculated on a "conservatively high basis." *Id.*

priately included estimates for plants processing blends between cotton and synthetics.[124] Further, OSHA found that RTI neglected the cost advantages available when compliance is achieved through moderizing rather than retrofitting the machinery.[125] RTI also assumed industry-wide compliance with the old standard of 1,000 $\mu g/m^3$.[126] Thus, RTI estimated only the incremental cost necessary to achieve compliance with the new PEL. This estimate necessarily was inaccurate, as some of the industry had not yet complied with the old standard, while other plants already had met the stricter new standard.[127] Further, industry witnesses testified that "substantial amounts of [recommended] controls are, in fact, in operation." [128]

OSHA found the industry's capital cost estimates to be overstated as well. Like RTI, the industry estimated only the costs of retrofitting old machines; it did not consider replacing them with new machines that are more productive and generate less dust.[129] Similarly, the in-

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[124] OSHA excluded from its final standard equipment producing synthetic fibers because it does not generate cotton dust. Yet such equipment was included in the RTI estimates for cotton blend plants. 43 Fed. Reg. 27370 (1978). On the basis of RTI calculations, OSHA found that exclusion of equipment used to produce synthetics could reduce compliance costs by as much as 30 percent. *Id.* at 27372, 27380 Table I & n.4; OSHA Brief at 113.

[125] 43 Fed. Reg. 27370-71 (citing testimony of Dr. Parker C. Reist that the cost of control declines with more productive, new machines).

[126] *Id.* at 27370. The existing standard set the cotton dust exposure level at 1000 $\mu g/m^3$. *See* TAN 27 *supra* (history of the standard).

[127] 43 Fed. Reg. 27370.

[128] *Id.* (testimony of Harold Imbus and Hovan Hocutt).

[129] The agency included this statement in its reasons for concluding that the AMTI estimate was exaggerated:

> While OSHA recognizes the validity of estimating compliance costs for retrofit controls, OSHA also recognizes

dustry "may have included some equipment which is used exclusively for synthetics" and thus inappropriately included in cotton dust control cost estimates.[130] The agency also noted that the industry estimates failed to account for improvements in technology that can reasonably be expected during the four-year compliance period.[131]

Finding both sets of capital cost estimates in the record to be exaggerated, the agency chose to rely on the substantially lower industry estimate. Unlike the RTI study, the industry's assessment reflected concrete data on actual industry dust levels and use of controls.[132]

Ironically, it is now the industry that challenges the accuracy of its own data.[133] The textile industry petitioners argue that OSHA's reliance on the industry's capital cost estimate is invalid because it is "wholly unrelated to the exposure limits set by the Standard." [134] The industry notes that its $550 million figure was advanced as the projected capital cost of compliance with a PEL of 200 $\mu g/m^3$ in opening through roving, 500 $\mu g/m^3$ in spinning through warping, and 1000 $\mu g/m^3$ in

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> the existing trend toward replacement of conventional machines with newer equipment which is more productive and produces less dust and which would lead to the prediction of fewer machines to be retrofitted or to be controlled [.]

43 Fed. Reg. 27372.

[130] *Id.*

[131] *Id.*

[132] AMTI cost estimates were based on a recent survey it conducted. 43 Fed. Reg. 27371 (1978). OSHA concluded, "Since AMTI estimates are based on more recent data, OSHA believes them to be more realistic than those offered by [RTI]." *Id.* at 27373.

[133] Textile Brief at 39.

[134] Textile Brief at 41.

slashing and weaving.[135] Thus, for spinning through weaving, the industry's estimate assumed a PEL requirement higher than the ones ultimately adopted—the 200 $\mu g/m^3$ level for spinning through warping and 750 $\mu g/m^3$ in slashing and weaving. The textile industry contends that by ignoring this fact, OSHA's final standard is based on a grossly understated cost estimate.

OSHA, however, marshals sufficient support and analysis for its decision to use the industry's capital cost estimate. Contrary to the industry's claim that this estimate is "wholly unrelated" to the PELs in the final standard, OSHA's technological assessment concluded that little more than the dust control measures assumed by the industry would be necessary to achieve the final PEL.[136] OSHA also explained that even the industry capital estimates were exaggerated because they included some unnecessary costs.[137] Thus, OSHA reasonably viewed the industry's figure as an overstated estimate for exposure levels set slightly higher than those in the agency's final standard.

Since the only other available figure was the far less accurate RTI estimate[138] the agency's ultimate reliance on the industry's capital cost estimate is reasonable. The RTI estimate lacked a basis in the industry's actual dust reduction. It also presumed a PEL for weaving and slashing far lower than the final PEL, which more nearly

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[135] 43 Fed. Reg. 27371, 27380 Table I & n.1 (1978).

[136] OSHA Brief at 112 (discussing determination that local exhaust ventilation would not be necessary for spinning and twisting operations).

[137] *See* TAN 129 *supra*.

[138] *See* TAN 132 *supra*.

approximated the exposure level and control technology assumed by the industry.[139]

The very nature of economic analysis frequently imposes practical limits on the precision which reasonably can be required of the agency. This is especially the case where, as here, the industry chooses to withhold from the agency part of the data underlying the industry's cost estimates.[140] OSHA's mandate authorizes it to promulgate standards on the basis of the "best available evidence." [141] We find that OSHA reasonably evaluated the cost estimates before it, considered criticisms of each, and selected suitable estimates of compliance costs.[142]

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[139] OSHA concluded:

> Most of the changes from the proposal in this final regulation have cost reducing effects. The principal cost reducing change is the increase in the permissible exposure level from 200 to 750 $\mu g/m^3$ for slashing and weaving. In some cases of control costs this difference in cost as a result of the higher PEL is not assessed. However, in other cases of control costs, such as slashing and weaving, because the need for certain engineering controls and/or amounts of air and filtration would be changed costs were shown to be reduced significantly. For this reason OSHA has adopted the [AMTI] estimate for slashing and weaving which predicted a level of 1,000 $\mu g/m^3$ instead of the RTI estimate for slashing and weaving at 200 $\mu g/m^3$.

43 Fed. Reg. 27371 (1978).

[140] The industry declined to give the agency access to its survey data or its detailed estimation methodology. 43 Fed. Reg. 27373; OSHA Brief at 113. This impaired the agency's ability to construct more accurate cost estimates once it found both the industry and RTI estimates inaccurate.

[141] 29 U.S.C. § 655(b)(5) (1976).

[142] *See* note 132 *supra*. OSHA decided to rely on the RTI estimates for the cost of non-engineering provisions, such as monitoring workers' health and providing respirators as needed. 43 Fed. Reg. 27372 (1978). OSHA considered these

b. Feasibility of compliance costs

The actual test for economic feasibility has yet to be fully developed by the courts.[143] This court has suggested that the costs cannot be "prohibitively expensive" for Congress would not have intended OSHA to make "financial viability generally impossible" for a regulated industry.[144]

Here, the agency had evidence in its record that the industry would be able to pass compliance costs on to consumers.[145] Although the record also contained testimony suggesting that older and smaller firms might bear a disproportionate financial burden,[146] it does not support the industry's claim of infeasibility. Even if a few firms are forced to shut down, the standard is not necessarily economically infeasible. As this court observed in *Industrial Union*,

> It would appear to be consistent with the purposes of the Act to envisage the economic demise of an employer who has lagged behind the rest of the industry in protecting the health and safety of employees and

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estimates to be overstated because they failed to account for compliance with these provisions in some plants prior to the standard, *id.* at 7372-73, but as the industry offered little evidence on non-engineering costs, OSHA reasonably relied on the RTI estimates.

[143] Berger & Riskin, *Economic and Technological Feasibility in Regulating Toxic Substances Under the Occupational Safety and Health Act*, 7 ECOLOGY L. Q. 285, 285-86 (1978).

[144] Industrial Union Department v. Hodgson, 499 F.2d 467, 478 (D.C. Cir. 1974).

[145] 43 Fed. Reg. 27370 (RTI assumed that costs of compliance will be passed on).

[146] *Id.* at 27377-78 (citing testimony of Arthur Figh, Vice President, Chase Manhattan Bank).

> is consequently financially unable to comply with new standards as quickly as other employers.[147]

Here the agency expressly concluded "that although some marginal employers may shut down rather than comply, the industry as a whole will not be threatened by the capital requirements of the regulation." [148]

Of course, the agency's underlying cost estimates are not free from imprecision. Nonetheless, on reviewing the record we believe that OSHA fairly considered all the economic data submitted before constructing its estimates. The agency responded to significant criticisms of the cost estimates it used, and explained the economic impact it projected for the textile industry. As a result, this court is satisfied that OSHA has substantial support in the record for its cost estimates and findings of economic feasibility for the textile industry. The position of the union petitioners on this issue [149] buttresses

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[147] Industrial Union Department v. Hodgson, 499 F.2d 467, 478 (D.C. Cir. 1974).

[148] 43 Fed. Reg. 27378 (1978). Further, alleged changes in the market structure of the industry do not signify economic infeasibility especially here, where the agency observed that textile manufacturing already tends toward increasing concentration. *Id.*

[149] In *Industrial Union*, this court observed that "Congress does not appear to have intended to protect employees by putting their employers out of business." 499 F.2d at 478. The Union here submits that its support of the cotton dust standard "demonstrates that it will have no such result." Union Reply Brief at 25. *See* American Iron and Steel Institute v. OSHA, 577 F.2d 825, 836-37 (5th Cir. 1978), *petitions for cert. pending*, Nos. 78-911, 78-1036 (court attaches significance to Union support in determining economic feasibility of OSHA standard).

OSHA's conclusion that the standard will not put the industry out of business.[150]

3. *Cost-Benefit and Cost-Effectiveness Analysis*

Industry petitioners would have this court impose an additional constraint on OSHA's authority to determine standards. They claim that under the feasibility requirement, OSHA must demonstrate that "the benefits of the standard are in proportion with the costs which it imposes." [151] This amounts to a claim that no standard may be promulgated under section 6(b)(5) of the Act absent a formal cost-benefit analysis.[152] The industry

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[150] The Union's assessment is not, however, determinative of the entire standard's economic feasibility. We must reject the Union's contention that the 750 $\mu g/m^3$ PEL which OSHA set for slashing and weaving operations must be remanded because it is not the lowest feasible exposure level. *See* Union Brief at 42. The record contains dose-response data showing reduced symptoms of byssinosis in the weaving area. 43 Fed. Reg. 27360 (1978) (discussing J.A. 218, 247, 361). OSHA determined that the presence of sizing in the weaving rooms tends to dilute the cotton dust and therefore allows for a greater permissible exposure level. Further, the technological obstacles to achieving a 200 $\mu g/m^3$ PEL in the weaving area pose extreme compliance costs. Meeting these costs would impede the industry's ability to achieve the 200 $\mu g/m^3$ level where it is more essential—in the opening through warping operations. *Id.; see* J.A. 2241-43. Thus, the agency reasonably adopted a higher PEL in slashing and weaving to permit compliance in the earlier stages of textile manufacturing where the dust exposure poses a more serious threat to health.

[151] Textile Brief at 53. In the industry's view, OSHA's failure to evaluate costs against benefits renders the agency's finding of economic feasibility invalid. *Id.* Similar arguments are made by National Cotton Counsel of America (NCCA), *see* NCCA Supplemental Brief at 15-16, and the petitioners from nontextile industries, *see* Nontextile Brief at 62-64.

[152] Cost-benefit analysis involves calculating the costs and benefits of various programs to compare their net present

similarly argues that OSHA must justify the expense imposed by its standard by comparing it with the industry's proposed alternative.[153]

OSHA agrees that a systematic evaluation of costs and benefits is to be *encouraged* within the limits of available estimation techniques,[154] yet it contends that such analysis is not *required.* OSHA argues that the OSH

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values. E. QUADE, ANALYSIS FOR PUBLIC DECISIONS 26-27 (1975). A study by The National Academy of Sciences concluded that cost-benefit analysis

> is not a rule or formula which would make the decision or predetermine the choice for the decision maker. Rather, it refers to the systematic analysis and evaluation of alternative courses of action drawing upon the analytical tools and insights provided by economics and decision theory. It is a framework and a set of procedures to help organize the available information.

NATIONAL ACADEMY OF SCIENCES, DECISION MAKING FOR REGULATING CHEMICALS IN THE ENVIRONMENT 39 (1975) (report prepared by National Research Council).

[153] Textile Brief at 54, 56 (citing section 3(8) of the Act, 29 U.S.C. § 652(8) (1976)). Essentially, petitioners here claim that the agency should have conducted an analysis of the cost-effectiveness of both the agency's dust control strategy and the industry's proposed alternative. In contrast to cost-benefit analysis, cost-effectiveness is only used to compare alternatives for reaching the same goal. Like cost-benefit, cost-effectiveness analysis often raises intractable problems in obtaining the requisite measures that enable comparison. QUADE, *supra* note 152 at 25-28. Although the two kinds of analysis differ, the petitioners raise essentially the same claim with each one: they ask us to find OSHA's failure to employ these methods a fatal flaw in its proceedings.

[154] 43 Fed. Reg. 27378 (1978). The agency noted that "although the benefits of the standard cannot rationally be quantified in dollars, OSHA has given careful consideration to the question of whether these substantial costs are justified in the light of the hazards of exposure to cotton dust." *Id.* at 27379.

Act constrains its regulation of dangerous substances "only by the limits of feasibility." [155] We agree. We also find that no additional constraint is imposed by the Act's definition of a health or safety standard as "reasonably necessary or appropriate to provide safe or healthful employment." [156] The language of the Act and the clear intention of Congress permit no other conclusion.

Other statutory schemes explicitly require such particular kinds of analysis. In the Clean Air Act, for example, Congress required the Environmental Protection Agency to perform a "cost benefit analysis" before prohibiting the manufacture or sale of a fuel or fuel additive which endangers public health or welfare.[157] Some Congressional Acts require a showing of "unreasonable risk" prior to regulation.[158] The legislative histories of these acts have led the courts to construe this provision to require regulatory agencies to balance costs and benefits of proposed action.[159]

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[155] *Id.* at 27378.

[156] 29 U.S.C. § 652(8) (1976).

[157] 42 U.S.C. § 1857f-6c(c)(2)(B) (1976). *See also* Federal Environmental Pesticide Control Act of 1972, 7 U.S.C. § 136 (bb) (1976) (determining "unreasonable risk to man or the environment" includes consideration of "economic, social, and environmental costs and benefits of the use of any pesticide").

[158] *E.g.*, Federal Hazardous Substances Act, 15 U.S.C. § 1261s (1976) (article is mechanical hazard if it presents "unreasonable risk of personal injury or illness"); Consumer Products Safety Act, 15 U.S.C. § 2058(c)(2)(A) (1976) (rule must be "reasonably necessary to eliminate or reduce an unreasonable risk of injury"); Toxic Substances Control Act, 15 U.S.C. § 2605(a) (1976) (requirements may be imposed if chemical presents "unreasonable risk of injury to health or the environment").

[159] *E.g.*, Forester v. Consumer Product Safety Comm'n, 559 F.2d 774, 789 (D.C. Cir. 1977) (footnote omitted):

> The requirement that the risk [posed by mechanical hazards] be "unreasonable" necessarily involves a balancing

In the OSH Act, in contrast, Congress itself struck the balance between costs and benefits in the mandate to the agency. Section 6(b)(5) unequivocally mandates OSHA to

> set the standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that *no employee will suffer material impairment* of health or functional capacity.[160]

Thus Congress concluded that the benefits of health protection warranted the expense of an effective standard.[161]

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test like that familiar in tort law: The regulation may issue if the severity of the injury that may result from the product, factored by the likelihood of the injury, offsets the harm the regulation itself imposes upon manufacturers and consumers.

See also Aqua Slide "N" Dive v. Consumer Product Safety Comm'n, 569 F.2d 831, 839, 844 (5th Cir. 1978) (using *Forester* balancing test definition for "unreasonable risk"); *id.* at 845 (Wisdom, J., concurring) (requiring substantial evidence for Commission's cost-benefit analysis).

As OSHA points out, when Congress wishes to require cost-benefit analysis, it does so explicitly; when it wishes a feasibility constraint instead, it so states. *See* OSHA Brief at 121 n.96 (citing legislative history of Mine Safety and Health Amendments of 1977, where Congress rejected amendments that would insert cost-benefit analysis).

[160] 29 U.S.C. § 655(b)(5) (1976) (emphasis added).

[161] Senator Eagleton, for example, stated during floor debates on the Act that

> The Costs that will be incurred by employers in meeting the standards of health and safety to be established under this bill are, in my view, reasonable and necessary costs of doing business. Whether we, as individuals are motivated by simple humanity or by simple economics, we can no longer permit profits to be dependent upon an unsafe or unhealthy workplace.

LEGIS. HIST. at 1150-51 (from the Congressional Record, Senate, Dec. 16, 1970).

In the legislative debates on the Act, Senator Yarborough who sponsored the bill responded in no uncertain terms to the claim that the proposed legislation would be too expensive:[162]

> We are talking about people's lives, not the indifference of some cost accountants. . . . We are talking about assuring our American workers who work with deadly chemicals that when they have accumulated a few years seniority they will not have accumulated *lung congestion* and poison in their bodies, or something that will strike them down before they reach retirement age.[163]

In contrast to the Acts for which Congress contemplated a cost-benefit requirement, the legislative history of the OSH Act contains no reference to this kind of economic analysis.[164]

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[162] Senator Yarborough preceded the statement quoted in text with this comment:

> [W]hen Congressman O'Hara and I introduced into the House and Senate the first comprehensive occupational health and safety bill, we drew the critical fire of several organizations who claim that legislation of this type is too expensive.
>
> One may well ask too expensive to whom? Is it too expensive for the company who for lack of proper safety equipment loses the service of its skilled employees? Is it too expensive for the employee who loses his hand or leg or eyesight? Is it too expensive for the widow trying to raise her children on meager allowance under workman's compensation and social security? And what about the man—a good hard-working man—tied to a wheel chair or hospital bed for the rest of his life? That is what we are dealing with when we talk about industrial safety.

LEGIS. HIST. at 510.

[163] *Id.* (emphasis added).

[164] Instead, Congress anticipated severe costs from the health and safety standards and provided a program of loans

Instead, Congress determined in the OSH Act that any severe risk to employee health must be eliminated or reduced if feasible means to do so exist.[165] This calls for a two-step analysis by the agency: (1) determining whether health impairment is threatened by the suspect substance, and (2) determining whether the selected strategy is to protect workers from this risk is both technologically and economically feasible. Nothing in the statute or its legislative history requires a further determination that the costs of the standard bear a "reasonable" relationship to its benefits.[166] Nor may this court impose

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to small businesses seriously affected by OSHA standards. *See* section 28 of the Act (amending section 7(b) of the Small Businesses Act, 15 U.S.C. § 636 (1976)); Cong. Record (Senate) (Nov. 17, 1970), LEGIS. HIST. at 525-26 (remarks of Sen. Dominick).

[165] The House Report concluded:

> Even the price of one life is too expensive when a meaningful occupational safety and health law could save many lives. . . . The well-being of every American working man and woman is an essential human right which we can no longer deny.

H.R. Rep. No. 91-1291, 91st Cong., 2d Sess. 35 (1970), *reprinted in* LEGIS. HIST. at 865.

[166] Petitioners mistakenly believe that cost-benefit or cost-effectiveness analysis is mandated by the "reasonably necessary or appropriate" language in the Act's definition of health and safety standards. In another context, this court construed the familiar "necessary or appropriate" provision as authorizing "an agency to use means of regulation not spelled out in detail, provided the agency's action conforms with the purposes and policies of Congress and does not contravene any terms of the Act." Niagara Mohawk Power Corp. v. FPC, 379 F.2d 153, 158 (D.C. Cir. 1967). In this light, the "reasonably necessary or appropriate" language grants OSHA considerable discretion in adopting protective strategies to guard against particular health risks. While cost-benefit and cost-effectiveness analyses are techniques that can assist evaluations of such strategies, they are not required by the Act's provisions.

additional procedural requirements.[167] Indeed, the only authorities cited by petitioners are not binding on this circuit,[168] and in any event, they are not persuasive in this context.[169]

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[167] Under the Supreme Court's decision in Vermont Yankee Power Corp. v. Natural Resources Defense Council, 435 U.S. 519, 524 (1978), this court may not require OSHA to conduct cost-benefit analysis unless the agency or Congress officially requires this procedure. Such analysis is certainly not mandated in explicit terms by the statute. Nor is it implicated in the extra-statutory procedures OSHA followed in promulgating the cotton dust standard. *See* TAN 54-55 *supra* (discussing OSHA's additional procedures); *Judicial Review of Informal Rulemaking Procedure: When May Something More Formal Be Required?*, 27 AM. U. L. REV. 781, 811 (1978).

[168] Petitioners rely on Turner Co. v. Sec'y of Labor, 561 F.2d 82 (7th Cir. 1977) (noise abatement enforcement action) and three cases of another circuit, American Petroleum Institute v. OSHA, 581 F.2d 4931 (5th Cir. 1978), *cert. granted*, 47 U.S.L.W. 3554 (Feb. 20, 1979) (Nos. 78-911, 78-1036); Aqua Slide "N" Dive Corp. v. Consumer Product Safety Commission, 569 F.2d 831, 844 (5th Cir. 1978) (swimming pool slides); and Florida Peach Growers Ass'n v. Dep't of Labor, 489 F.2d 120 (5th Cir. 1974) (pesticide residue). *See* Textile Brief at 37-38, 53-59.

This court, however, is bound by its construction of the feasibility requirement in Industrial Union Department v. Hodgson, 499 F.2d 467, 477-78 (D.C. Cir. 1974) (asbestos dust), which has been adopted in American Iron & Steel Inst. v. OSHA, 477 F.2d 825, 835-36 (3d Cir. 1978) (coke oven emissions), *petitions for cert. pending*, Nos. 78-918, 78-919; AFL-CIO v. Brennan, 530 F.2d 109 (3d Cir. 1975) (revoking rule against permitting any workers' hands in machine dies). *See* TAN 92-94 *supra*.

[169] Petitioners' reliance on American Petroleum, *supra*, is especially unpersuasive. The Fifth Circuit there based its holding on its earlier interpretation of an entirely different statutory scheme in Aqua Slide "N" Dive Corp. v. Consumer Product Safety Commission, *supra*. *Aqua Slide* involved the Consumer Products Safety Act, 15 U.S.C. § 2058(c)(2)(A) (1976), which employs the "unreasonable risk" language

Further, cost-benefit analysis would not necessarily improve agency health and safety determinations.[170] These techniques require the expression of costs, benefits and performance in often arbitrary, measureable terms.[171] They may hide assumptions and qualifications in the

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that courts have construed to require a balancing test. *See* n.158 *supra*. No such language appears in the OSH Act provisions under which the cotton dust standard was issued. Congress apparently drew the sensible conclusion that consumers often may be in a better position than workers to estimate and avoid risks. Petitioners' view that the "reasonably necessary or appropriate" language requires cost-benefit analysis, Textile Brief at 55, is similarly misguided. *See* TAN 156 *supra*.

Finally, petitioners mistakenly rely on two more cases from other circuits that have little relevance to this case. *Florida Peach Growers Association v. Dep't of Labor*, *supra*, concerned the issuance of emergency standards under § 6(c) of the Act, 29 U.S.C. §)655(c) (1976). *Turner Co. v. Sec'y of Labor*, *supra*, similarly is inapposite. It involved the appeal of an enforcement proceeding against a single manufacturer under an existing noise standard. Although requiring a cost-effectiveness analysis by the agency the Seventh Circuit in *Turner Co.* explicitly endeavored to distinguish the noise regulated in that case from other hazards that pose "serious debilitating threats." *Id.* at 86. Just such a serious risk is posed by cotton dust exposure.

[170] *See* P. Schuck, *Regulation: Asking the Right Questions*, 11 NAT'L J. 711, 711 (1979):

> Cost-benefit analyses are also invariably flawed. The reasons for this are well-known: the difficulty of identifying and quantifying many costs and benefits; the inevitably arbitrary nature of valuations of human life or health; . . . the problem of interpersonal and intergenerational comparisons of utility; and many others.

[171] The National Academy of Sciences report, *supra* at 39-44, identifies this measurement problem and the general difficulty of estimating uncertain effects as serious shortcomings of cost-benefit analysis. For a similar view, *see* QUADE, *supra* at 25-26.

seeming objectivity of numerical estimates. Especially where a policy aims to protect the health and lives of thousands of people, the difficulties in comparing widely dispersed benefits with more concentrated and calculable costs may overwhelm the advantages of such analysis.[172]

OSHA considered the alternative proposed by the industry and found it inadequate to protect against the health risk at issue. We recognize that the agency's control strategy is costly. But it is the result of long and comprehensive investigation by the agency assisted by extensive public participation.[173] We find that the health risk posed by cotton dust warranted agency action, and that the final standard chosen by the agency is technologically and economically feasible for the textile industry within the meaning of the Act.[174]

IV. Non-Textile Industries

In the final standard, OSHA set a permissible exposure level of 500 $\mu g/m^3$ for all non-textile industries covered by the standard.[175] Three such industries here

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[172] Not only are the benefits of the regulation dispersed over thousands of people, they are also spread over lifetimes. The delayed effect of cotton dust exposure causes one of the difficulties in estimating its harm. In directing OSHA to promulgate standards on the basis of the "best available evidence," 29 U.S.C. § 655(b)(5) (1976), Congress wished to avoid administrative paralysis caused by experts' debates. H.R. No. 91-1291, 91st Cong., 2d Sess. 18 (1970), Legis. Hist. at 848. Certainly, it would not have wanted administrative paralysis caused by debate over a standard's cost and benefits.

[173] *See* TAN 30-34 *supra.*

[174] *See* TAN 97-150 *supra.*

[175] 43 Fed. Reg. 27360, 27395 (1978) (§ 1919.1043(c)(3)) (standard for all workplaces except yarn manufacturing and slashing and weaving).

challenge the standard:[176] (1) the cottonseed oil mills, which process cottonseed and its byproducts; (2) the cotton warehouses, which store raw, baled cotton; and (3) the classing offices, which classify samples of cotton fiber.[177]

The non-textile petitioners claim that OSHA failed to establish that their workers risk material health impairment and that the PEL set for these industries is arbitrary. Further, they claim that the standard is infeasible on both technological and economic grounds.

A. *Health Risks and Permissible Dust Exposure*

Petitioners do not dispute that their employees are exposed to cotton dust,[178] often at higher levels than in textile mills. They assert, however, that the work processes, dust composition, and worker exposure to dust in nontextile industries differ significantly from the textile industry.[179] In this way, petitioners seek to challenge OSHA's general position that exposure to cotton

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[176] *See also* note 1 *supra*.

[177] Non-Textile Brief at 4. OSHA explained that the standard applies to

> all non-textile industries including but not limited to: warehousing, compressing of cotton lint, classing and marketing, using cotton yarn (i.e., knitting), reclaiming and marketing of textile manufacturing waste, delinting of cottonseed, marketing and converting linters, reclaiming and marketing of gin motes and batting, yarn felt manufacturing using waste cotton fibers and by products.

43 Fed. Reg. 27360 (1978).

[178] Instead, petitioners argue that the composition of the dust in their workplaces differs from the dust in textile mills, Non-Textile Brief at 34-38.

[179] *E.g.*, Non-Textile Brief at 33.

dust poses a serious hazard to workers regardless of where the dust is encountered.[180]

The exact nature of the health hazard posed by cotton dust remains subject to medical debate.[181] The agency had before it conclusive evidence that dust found in textile mills causes debilitating disease;[182] it also had some evidence of related, though less severe, health impairments among workers in nontextile industries.[183] Although petitioners point to differences among the industries, OSHA's mandate requires it ot protect workers in all industries.[184] We find that OSHA fulfilled this mandate by reasonably relying on medical evidence from the textile industry[185] and evidence of health impairments

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[180] *See* 43 Fed. Reg. 27360-61 (1978).

[181] Petitioners claim that the bract and leaf-like trash is the element in cotton dust most likely to cause disease. Non-Textile Brief at 34. On this theory, petitioners attempt to distinguish the dust in their industries from the dust in the textile mills. *Id.* at 35-39. In so doing, petitioners rely on some studies that were not in the rulemaking record, *id.* at 34 n. 103, and ignore others actually in the record that contradict their conclusion, *see, e.g.*, J.A. 12.1 (Dr. Bouhuys). The agency fully explains the nature of the debate. 43 Fed. Reg. 27354 (1978). This court will not reach beyond the record to displace the agency's judgment that conclusive evidence is not yet available to isolate the causal agent.

[182] *See* Part III *supra.*

[183] *E.g.*, Report on the Evaluation of Respiratory Effects of Cottonseed Dust Inhalation (1976) (Jones & Weill study), J.A. 408-35 (acute broncho-constrictor effect in cottonseed oil mill employees); Testimony of Dr. Martin Barman, J.A. 2972 (1978) (pulmonary function decrements in warehouse employees)

[184] 29 U.S.C. § 655(b) (5) (1976).

[185] Courts have approved OSHA's extrapolations from evidence of carcinogens in one industry to another, related industry, *e.g.*, Soc'y of Plastics v. OSHA, 509 F.2d 1301, 1310

among nontextile workers.[186] The differences in the industries that were cited by petitioners do not undermine the agency's determination.

(2d Cir. 1975) (fabricators of products using PVC resins). This court has permitted an agency to draw on studies of one carcinogent to regulate another, related substance. EDF v. EPA, 578 F.2d 63, 83-85, (D.C. Cir. 1978) (approving extrapolation from knowledge about highly chlorinated polychlorinated biphenyls (PCBS) to less chlorinated PCBs). Petitioners claim that this case is inapplicable here because the court relied on the "ample margin of safety" section 307(a) of provision in Federal Water Pollution Control Act Amendments of 1972. 33 U.S.C. § 1317(a) (1976). Non-Textile Reply Brief at 16-17. For the purposes of permitting extrapolations, OSHA's duty to ensure that "no employee will suffer material impairment of health," 29 U.S.C. § 655(b)(5), is no less protective than the "ample margin of safety" provision. Further, deference to agency expertise and recognition of administrative feasibility also contributed to this court's approval of the agency's use of inference and extrapolation in *EDF v. EPA*. *Id.* at 46-48. These considerations apply with equal force here. *See also* American Federation of Labor v. Brennan, 530 F.2d at 115 (reviewing court does not sit to determine "scientific superiority" of agency's extrapolations).

[186] OSHA pointed to foreign studies of severe health impairments in nontextile industries, *e.g.*, Noweir, *et al.*, *Exposure to dust in the Cottonseed Oil Extraction Industry*, 19 ARCH. ENVIRON. HEALTH 99 (1969), J.A. 3210 (byssinotic symptoms in 35 out of 110 cottonseed oil mill workers); Barnes & Simpson, *Ventilary Capacity Changes on Expsoure to Cotton Dust*, MED. J. OF AUSTRALIA, 897 (May 25, 1968), J.A. 3218 (chest tightness and wheezing among workers in delinting and cottonseed storage industries). Petitioners criticize OSHA's reliance on these studies because the foreign plants differ from domestic ones. J.A. 3319; Non-Textile Brief at 23-26.

OSHA also had evidence of lung impairments in domestic nontextile industries, but generally these effects were less severe. (*E.g.*, Statement of Dr. K. D. McMurrain, J.A. 2719. (reviewing Jones and Weill Study of cottonseed oil mills).

The agency did acknowledge that health effects in the nontextile industries appear to be less prevalent and less severe than in the textile mills,[187] but concluded that the individual nontextile workers still run the risk of material health impairment. The agency reasoned that high worker turnover and movement in the workplace, rather than a lesser risk from exposure to dust, may explain the less severe aggregate pattern of disease.[188] We find no reason to disturb this judgment in favor of the more dubious conclusion that the nontextile workers are not endangered.

Moreover, the agency took account of the pattern of health effects when it raised the final PEL for the nontextile industries to 500 $\mu g/m^3$ from the proposed 200 $\mu g/m^3$ level.[189] The agency fairly concluded that the industries' data lent guidance to the permissible dust exposure level, but did not cast doubt on the agency's evidence of health risks to nontextile workers.[190]

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[187] 43 Fed. Reg. 27361 (1978).

[188] *Id.* (citing Statement of Phillip J. Wakelyn, National Cotton Council of American, J.A. 2698-2704, and other testimony in the record).

[189] 43 Fed. Reg. 27355 (1978).

[190] *Id.* The industry challenges the PEL as arbitrary. OSHA admits that "in the absence of detailed dose-response data, the risk to workers from cotton dust generated in many segments of the non-textile industry cannot be precisely defined." *Id.* Yet OSHA's mandate calls for standards "expressed in terms of objective criteria and of performance desired" whenever practicable. 29 U.S.C. § 655(b)(5)(5) (1976). To this end, the agency reasonably selected the PEL of 500 $\mu g/m^3$. The agency explained that this level for only respirable dust is roughly equivalent to the pre-existing theshold limit of 1.0 mg/m^3 of total dust. 43 Fed. Reg. 27361 (1978). *See* TAN 24-26 *supra*. Although expressing reservations, Merchant suggested 500 $\mu g/m^3$ as "not an unreasonable approach" pending further study. Tr. 1297, J.A. 3696. We agree.

OSHA thus explained the evidence it used, the reasons for its conclusions, and its responses to the industries' evidence and objections. When agencies are entrusted with regulating risks on the frontiers of scientific and medical knowledge, we cannot ask for more.[191]

Petitioners nevertheless argue that we should find it arbitrary and unreasonable for OSHA to set the standard before NIOSH completes its study of the nontextile industries.[192] Certainly, OSHA should take advantage of the ongoing research of NIOSH and other major inquiries into occupational health and safety. But by law, OSHA need not wait for NIOSH recommendations before protecting against occupational health risks.[193] Nor are

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[191] *See* Amoco Oil Co. v. EPA, 501 F.2d 722, 741 (D.C. Cir. 1974):

> Where . . . the regulations turn on choices of policy, on an assessment of risks, or on predictions dealing with matters on the frontiers of scientific knowledge, we will demand adequate reasons and explanations, but not "findings" of the sort familiar from the world of adjudication.

In Soc'y of Plastics v. OSHA, 509 F.2d at 1308, the Second Circuit observed that "though the factual finger points, it does not conclude." Nonetheless, the court concluded that OSHA is authorized "to act even in circumstances where existing methodology or research is deficient." *Id.*

[192] Non-Textile Brief at 42-44; Non-Textile Reply Brief at 10-14. Petitioners cite a NIOSH statement that identifies the limitations existing studies on non-textile cotton dust exposure. Non-Textile Brief at 42-44 (citing NIOSH Supporting Statement: Characteristics of Byssinosis in Segments of the Cotton Industry—Mattresses and Cotton Matting, Cottonseed Oil, Waste Recyclers, Cotton Warehousers and Cotton Classification Officers, J.A. 3036). NIOSH's criticisms were written to justify its decision to study the area, not to dispute the health risk posed by cotton dust in the non-textile industries.

[193] 29 U.S.C. § 655(b) (1976). Indeed, the Secretary may initiate the regulatory process on the basis of information submitted in writing to him by any interested person. 29

such recommendations conclusive.[194] A legitimate challenge to a health and safety standard can be raised as new data emerges,[195] but OSHA did not exceed its authority by regulating as soon as it knew of the risks of material health impairment from dust exposure.[196]

B. *Feasibility*

Judgments about the technological capabilities and financial positions of the industries affected by the stand-

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U.S.C. § 655(b)(1). OSHA is to base its standards on the "latest available scientific data in the field," 29 U.S.C. § 655 (b)(5), but it is not required to wait for data that is not yet available.

[194] NIOSH was created to assist OSHA in carrying out its general purposes and in fulfilling the research and training provisions of the statute. 29 U.S.C. § 671 (1978). This court determined that OSHA must consider all information made available by interested parties and experts, so determinations of NIOSH are only one factor in OSHA's deliberations. 499 F.2d at 476-77.

[195] An agency has a duty to revise its standards in light of new information. *See* Public Service Comm'n v. FPC, 511 F.2d 338 (D.C. Cir. 1975). OSHA has commendably committed itself to reviewing the standard it set for cotton gins "at the end of five years, or earlier if sufficient evidence of the need for a specific exposure limit is presented." 43 Fed. Reg. 27424 (1978) (standard to appear at 29 C.F.R. § 1910.1046, 1928.21). It would seem advisable for it to undertake a similar commitment for the non-textile standard at issue here.

[196] There seems no limit to petitioners' claim that OSHA has to wait for a pending study before promulgating the standard. After that study, there would always be another study, and then another, that could be deemed necessary contribution to the regulation. Congress did not intend OSHA to "be paralyzed by debate surrounding diverse medical opinion." H.Rep. 91-1291, 91st Cong., 2d Sess. at 18 (1970), *reprinted in* LEGIS. HIST. at 843. Rather, at OSHA concluded in this instance, "[p]rotection of employees cannot await resolution of all the points of scientific debate." 43 Fed. Reg. 27355 (1978).

ard depend on the evidence for each one, so we examine evidence on the warehouse, classing office, and cottonseed oil mill industries.

1. *Warehouses and Classing Offices*

The warehousing industry does not dispute the feasibility of the standard. Indeed, OSHA determined that most warehouses are already in compliance with the standard now that the final PEL for that industry has been raised to 500 $\mu g/m^3$.[197] For those portions of the industry not in compliance, the record indicates that improved ventilation and housekeeping will adequately assure compliance.[198]

OSHA also reasonably concluded that most classing offices[199] are "substantially in compliance" with the 500 $\mu g/m^3$ PEL.[200] Where dust control is necessary, the rec-

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[197] 43 Fed. Reg. 27368 (1978); J.A. 2961 (Statement of Phillip Wakelyn); J.A. 3008 (Nat'l Cotton Council of America, Economic Impact of OSHA's Proposed Cotton Dust Standard on Cotton Warehouses, 1977) (hereinafter cited as NCCA Warehouse Study). The industry and the agency both calculated exposure levels on a time-weighted basis, that is, averaged over a work day, because workers move in and out of dusty areas over the course of a day. NCCA Warehouse Study, J.A. 3010; Statement of Phillip Wakelyn, J.A. 2962; 43 Fed. Reg. 27395 (1978) (§ 1910.1043(c)(3)).

[198] *See* 43 Fed. Reg. 27368; NCCA Warehouse Study, J.A. 3009-11.

[199] Classing offices classify grades of raw cotton by examining small samples. *See* TAN 177 *supra*.

[200] 43 Fed. Reg. 27362 (1978). This finding is supported in the record. *See* J.A. 2339-40 (Hodgkins, Dep't of Agriculture, Control of Dust Levels in Cotton Classing Offices). As in warehouses, dust exposure in classing offices is calculated on a time-weighted basis. J.A. 3132 (Statement of American Cotton Shippers Association); 43 Fed. Reg. 27395 (1978) (§ 1910.1043(c)(3)).

ord supports OSHA's finding that minor ventilation modifications can effectively reduce dust exposure in classing offices to the requisite level.[201]

Thus we uphold the agency's finding that dust control is both technologically and economically feasible for warehousing and classing offices. These two industries claim, however, that non-engineering controls required by OSHA—medical surveillance and provision of respirators —will impose burdensome and unjustified costs.[202] Congress itself rejected this claim. It authorized the agency to regulate even if industries become financially burdened,[203] so long as the burden is not "prohibitively expensive." [204] OSHA need not "justify" its health and safety standards through a cost-benefit analysis [205] as the petitioners imply. Rather, OSHA must simply establish the risk of material health impairment and demonstrate the economic and technological feasibility of its standard for the regulated industries.[206] We hold that it has satisfied these requirements for the warehousing and classing office industries.

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[201] *See* 43 Fed. Reg. 27368 (1978); J.A. 2339-40 (Hodgkins, Dep't of Agriculture, Control of Dust Levels in Cotton Classing Offices).

[202] Non-Textile Brief at 60-62. As these petitioners maintain that OSHA failed to demonstrate a material health hazard in either the warehousing or classing office industries, they argue that the costs of complying with the standard are "completely unjustified." *Id.* at 63.

[203] *See* TAN 93-99 *supra*.

[204] Industrial Union Dep't v. Hodgson, 499 F.2d 467, 478 (D.C. Cir. 1974).

[205] *See* TAN 155-74 *supra*.

[206] *See* TAN 166 *supra*.

2. *Cottonseed Oil Mills*

Perhaps the most hotly contested aspect of the standard is its feasibility for the cottonseed oil industry. OSHA admits that considerable effort will be required for this industry to comply with the standard. We find that OSHA has adequately demonstrated the technological feasibility of the standard for this industry, but the record does not sufficiently establish its economic feasibility.

First, the record does sufficiently support the agency's conclusion that existing methods of dust control will permit compliance with the dust exposure level set for this industry. OSHA relied in part on evidence of dust control techniques already effective in related industries.[207] It also found support in the industry's own theoretical study that was designed as if the authors "were consulting engineers given the task of lowering dust levels in a typical cottonseed oil mill to the lowest feasible level." [208] As that study was commissioned by the industry in response to the proposed 200 $\mu g/m^3$ PEL,[209] we find no reason to disturb the agency's judg-

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[207] Ventilation, enclosure of dusty areas, use of modern equipment, and placement of hoods over particularly dusty machinery are techniques used in other industries that OSHA found applicable to the cottonseed oil mills. 43 Fed. Reg. 27369 (1978). *See* J.A. 1490 (Baier Statement); 2741 (Parnell Statement).

[208] OSHA relied on a theoretical study conducted by Dr. Calvin Parnell, Jr. for the National Cottonseed Products Association. *See* J.A. 2735 (Parnell Statement); J.A. 2865 (Parnell Study). The study described specific engineering controls and their costs for "a typical cottonseed oil mill processing 200 to 225 tons per day." J.A. 2868.

[209] The study did not specify the dust levels that would result from adoption of its recommended techniques for dust control. Parnell observed that "in accepting this assignment it was stipulated that the personnel working on this project

ment that the techniques proposed by the study would allow compliance with the final 500 $\mu g/m^3$ PEL.[210] Agencies are permitted to rely on estimates and policy judgments of this kind so long as they are fully explained and authorized by statute.[211] We therefore affirm the agency's finding of technological feasibility for this industry.

The agency's position on economic feasibility, in contrast, is neither clear nor adequately supported by the record. OSHA acknowledged that "[m]uch of the testimony on cottonseed processing . . . predicted dire eco-

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would not attempt to estimate the final concentrations that would result after implementation of these proposed engineering controls." J.A. 2875. The study was, however, commissioned by the industry in response to the proposed 200 $\mu g/m^3$ PEL, J.A. 2871, and did not find it impossible to attain that level.

[210] In addition to the claims addressed above the industry tries to bolster its infeasibility claim with the fact that the standard has not previously been enforced against the non-textile industries. Non-Textile Brief at 9 n.17. This previous history establishes only that a more limited definition of cotton dust prevailed before this standard was promulgated. *See* Sec'y v. Buckeye Cellulose Corp., OSHARC Doc. No. 1919 (Aug. 13, 1973), 367, J.A. 3246 (concerning cotton linters, a substance removed from cottonseed by the cottonseed oil mills). The standard before us employs a different, broader definition of cotton dust that includes the airborne dust in the non-textile industries. *See* Note 14 *supra*.

[211] Industrial Union v. Hodgson, 499 F.2d at 475-476. The Supreme Court noted recently that "complete factual support in the record for the [agency's] judgment or prediction is not possible or required" where assessments of future events are at issue. FCC v. Nat'l Citizens Comm. for Broadcasting, 98 S.Ct. 2096, 2122 (1978) (regulation of common ownership of broadcast station and newspaper in same community). *See also* Bradford Nat'l Clearing Corp. v. SEC, 590 F.2d 1085, 1103-04 (D.C. Cir. 1978) (judicial deference to agency increases where agency decision based primarily on predictions).

nomic effects including a substantial number of plant closings." [212] The industry estimated that 62 of the existing 83 mills, or approximately 52 percent of the industry's production capacity, will be forced to shut down if the standard is put into effect.[213]

In response, OSHA merely criticized the industry's estimate without constructing an alternative or fully explaining the basis for its criticism.[214] For example, OSHA suggested that the industry calculated "retrofit" costs twice.[215] Yet the agency never located these cal-

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[212] 43 Fed. Reg. 27374 (1978).

[213] Development and Planning Research Association, The Economic Impact of Proposed Cotton Dust Standards on the Cottonseed Processing Industry, VIII-8, J.A. 2855 (hereinafter cited as Cottonseed Impact Study). *See also* Tr. 3412-27, J.A. 4134-40 (Testimony of Mr. Wiseman, Vice-President of Development and Planning Research Association).

[214] 43 Fed. Reg. 27376.

[215] OSHA's position on "retrofit" estimate is in fact ambiguous. First, it explains that the industry's economic impact study devised an estimate that is 40 percent higher than the cost estimate of Parnell, designer of the theoretical technology assessment. 43 Fed. Reg. 27375 (1978). Yet OSHA admitted that "in the absence of further justification and breakdown of these costs by the industry, OSHA is unable to discount this economic impact estimate by any percentage." *Id.* Part of the confusion stems from the term "retrofit costs." Parnell explained that he used the term "retrofit" to mean costs he had not estimated for special space and construction problems in implementing the controls in particular, older plants. Tr. 3415-16, J.A. 4132-33. OSHA acknowledged that Parnell's "cost tables do not appear to reflect any such costs," yet claimed that Parnell's enclosure and isolation specifications may have entailed some of the costs also represented by the retrofit figure. None of OSHA's citations to Parnell's Study compare Parnell's figures with the "retrofit" cost. Moreover, it is Parnell's own statement that he did not include in his estimates the costs of modifications he called "retrofit." Tr. 3416, J.A. 4133. Thus, the record contains no evidence to support OSHA's claim that retrofit costs were included twice.

culations in the record nor identified the amount by which the cost estimate should be reduced to eliminate double-counting. Similarly, OSHA asserted without further explanation that the industry overstated production losses because the dust control strategy was designed to minimize such losses.[216] Also, OSHA claimed that the industry's cost estimate fails to acknowledge existing compliance with the standard, but the only evidence OSHA provides is the existence of a medical surveillance program in one company.[217] Absent more evidence on the extent of existing compliance, or the other asserted grounds of overestimation, we are unable to determine whether the industry's total cost estimate is unreasonable, as the agency contends. Even if the industry's estimate is exaggerated, OSHA offered no evidence that the cost of compliance will not cause "serious disruption," as petitioners claim.[218]

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[216] OSHA noted that the industry's estimated production losses were explained only as a result of reduced efficiency. 43 Fed. Reg. 27375 (1978). *See* Tr. 3421, J.A. 4134 (Testimony of Mr. Wiseman). OSHA concluded that such estimates were to some extent overstated because "Parnell's design study did include instances where the choice of design was based on the need to maintain efficiency." *Id.* This general statement is not clarified by citation to Parnell's Study, and thus this court finds no evidence in the record to support the agency's position on production losses.

[217] The agency cites one industry representative who "said the Buckeye division already had a medical surveillance program." 43 Fed. Reg. 27375 (1978) (citing Tr. 3396, 3397, 3410) (not included in Joint Appendix). The agency also noted that other industry representatives said "they did not know how many mills had surveillance programs." 43 Fed. Reg. 27375 (1978). Ignorance about the extent of compliance with one aspect of the standard, bolstered only by evidence of a medical surveillance program in one firm, cannot support the conclusion that incremental compliance costs will differ significantly from the industry's total estimates.

[218] *See* Cottonseed Impact Study, J.A. 2855.

Instead, the agency concedes that the standard may "accelerate" an existing trend of financial and economic decline in the cottonseed oil industry.[219] The agency apparently assumed that the standard's economic feasibility is not challenged because other factors will contribute to the anticipated shutdowns. In so assuming, the agency fails to indicate the number of shutdowns it anticipates or the role that the standard, as opposed to other economic pressures, will play in plant closings.[220]

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[219] OSHA asserts that

> to the extent that the existing secular decline in the number of mills continues and is accelerated by the costs of complying with the 500 $\mu g/m^3$ regulation, the industry estimate overstates the prediction of the capital costs of compliance by including the costs of all 83 firms presently in operation.

43 Fed. Reg. 27376 (1978). The force of this reasoning eludes us. The agency apparently concedes that the standard will contribute to the closing of some mills. Certainly, if some mills close, the industry's total compliance costs will decline. But this logic sidesteps the issue at hand: will the anticipated shut-downs so devastate the industray as to render the standard economically infeasible? *See* 499 F.2d at 477-78. Absent clearer indication of the agency's position, we cannot reach the question of what portion of an industry must be crippled by a standard for it to be deemed economically infeasible.

[220] As this court observed in *Industrial Union*,

> It would appear to be consistent with the purposes of the Act to envisage the economic demise of an employer who has lagged behind the rest of the industry in protecting the health and safety of employees and is consequently financially unable to comply with new standards as quickly as other employers. As the effect becomes more widespread within an industry, the problem of economic feasibility becomes more pressing.

499 F.2d at 478 (citation omitted). Without a clearer indication of the agency's reasoning in this case, we are unable to discern whether the scope of the anticipated shutdowns is consistent with the purposes of the Act or whether instead it

As a result, this court has no basis for reviewing the agency's conclusion that the standard is economically feasible for the cottonseed oil industry.[221]

Finally, the agency suggests that the industry will be able to pass the costs of the standard back to cotton growers.[222] OSHA argues that cotton growers will inevitably have a constant supply of cottonseed and will be willing to accept a lower price for the seed, shifting the loss forward to purchasers of raw cotton.[223] But the agency adduces no evidence or testimony to support this theory. In fact, the record shows only the contrary conclusion, drawn by the industry's economic impact study, that cotton producers will switch to other produce if the

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begins to put the standard's economic feasibility in jeopardy. Nor are we given a cost estimate that can be apportioned to the surviving mills, and thus no evidence as to their ability to bear the costs of the standard.

[221] The agency's position is too ambiguous for us to fully comprehend. Its apparent conclusion is that

> Some firms which may experience losses or *may apparently be marginal* in their profit position may decide to close. OSHA does not view such closings *necessary* as a result of regulation in view of secular decline in the number of oil mills over the decade.

43 Fed. Reg. 27376 (1978) (emphasis added).

[222] 43 Fed. Reg. 27375 (1978). OSHA acknowledges that it is unlikely that costs could be passed forward in the form of higher prices for cottonseed products. *Id.*

[223] [S]ince seed is a fiber byproduct, input supply for the industry is likely to be very price inelastic (amount of seed available generally remains the same regardless of price). Seed prices are subject to modification and costs as reflected in reduction of seed prices can be shifted forward by the fiber producers to the buyers of their main product, raw cotton.

43 Fed. Reg. 27375 (1978).

industry seeks to lower the price of cotton byproducts.[224] OSHA itself acknowledges that many past shutdowns of cottonseed oil mills have been due to contractions in the supply of cottonseed.[225] Absent more information, this court cannot determine whether the agency's cost pass-back theory adequately responds to the industry's estimate of massive shutdowns.

If the constraint of economic feasibility is to have any effect on the agency's rulemaking, it demands more serious consideration than it was given here.[226] The agency is allowed to rely on the best available evidence,[227] but here it simply gives general criticisms of the cottonseed industry's cost estimate. It failed to offer an alternative estimate of the standard's impact on this industry. As a result, the agency's position is too unclear to permit us to complete our reviewing function. We therefore re-

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[224] Cottonseed Impact Study, J.A. 2850; Tr. 3423-24, J.A. 4136037 (Testimony of Mr. Wiseman).

The study also concluded that assumptions about browers' conduct would not be made with confidence in light of the anticipated disruption from the entire standard. OSHA asserted that the final standard would not be disruptive, OSHA Brief at 118 n.94, but this would suggest only that it would not be impossible on that ground alone for costs to be passed back to the growers.

[225] 43 Fed. Reg. 27376 (1978) (citing Cottonseed Impact Study, J.A. 2781).

[226] In contrast, the agency carefully constructed a cost estimate for the standard's impact on the textile industry, and demonstrated that industry's ability to bear the estimated burden. *See* TAN 145-150 *supra*. The warehousing and classing office industries did not challenge the economic feasibility of the standard as they are already close to compliance, but the agency provided thorough responses to their claims that the standard is unjustified. *See* TAN 197-201 *supra*.

[227] Section 6(b)(5) of the Act, 29 U.S.C. § 655(b)(5) (1976).

mand this issue for clarification or reconsideration by the agency.[228]

V. Other Challenges

We conclude that the standard withstands the remaining challenges to the standard's implementation period, employee-transfer provision, and use of pulmonary function tables.

A. *The Four-Year Implementation Program*

The standard does not require any employer to complete implementation of engineering or work practice controls until four years after its effective date.[229] The textile industry challenges this time period as too stringent;[230] the union challenges it as too lax.[231] Both groups

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[228] We do not require the agency to establish the standard's economic feasibility in a particular way. It may pursue its cost-shifting theory or it may demonstrate an alternative estimate for costs or shutdowns, as long as it obtains substantial support from factual and policy materials.

[229] 43 Fed. Reg. 27395 (1979) (§ 1910.1043(e)(3)(g)(iii)). *See also id.* at 27387. The more stringent proposed standard would have required employers to achieve 500 $\mu g/m^3$ immediately, 350 $\mu g/m^3$ in four years, and 200 $\mu g/m^3$ in seven years. *Id.*

[230] Textile Brief at 34-37 (claiming industry-wide compliance with four years not technologically feasible). The textile industry also challenges the six-month period selected by OSHA for intial monitoring of employee health. Textile Brief at 73 (challenging § 1910.1043(m)(2)(i), 43 Fed. Reg. 27398 (1978)). Although testimony was offered in support of a twelve-month period, J.A. 3064-65, 4151, some major industries testified that they already have medical surveillance and dust monitoring programs. J.A. 1987-88, 2035. OSHA's selection of the six-month period reasonably reflected this evidence, and the availability of a variance should assist any employer for whom this provision proves a hardship.

[231] The unions argue that the four-year period will permit unnecessary delay by employers who could comply sooner. They claim that this result would violate OSHA's mandate to

of petitioners claim that the agency's decision lacks support in the record, authorization under the OSH Act, and adequate explanation by the agency.

We find no basis to petitioners' claims. OSHA reasonably set the four-year compliance period to accommodate the competing needs of employers who need time to achieve compliance and the needs of employees who need protection from health risks.[232] The agency decided that to meet the standard's requirements, employers should first monitor employee health, consult with experts, and prepare detailed compliance plans.[233] The four-year period it chose we find will permit orderly, industry-wide compliance.[234] Employers for whom this period is infeasible can seek an administrative variance.[235] The agency still

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set the standard which most adequately assures, to the extent possible . . . that no employee will suffer material impairment of health or functional capacity." Union Brief at 31 (citing Section 6(b)(5), 29 U.S.C. § 655(b)(5) (1976)). The union claims that OSHA should have required employers to achieve compliance "at the earliest possible time, but no later than" a specified date, as it did in setting permanent standards for arsenic, see 29 C.F.R. § 1910.1018(g), and for coke oven emissions, see 29 C.F.R. § 1910.1029(7)(1)(i)(a).

[232] Besides competing interests, OSHA had to evaluate conflicting estimates of the time necessary for compliance. 43 Fed. Reg. 27385 (1978).

[233] *Id.* at 27383-86; *id.* at 27395 (to be codified at 29 C.F.R. § 1910.1043(e) (1978)).

[234] This manner of implementation is well within the scope of the agency's appropriate concerns. *See* Industrial Union v. Hodgson, 499 F.2d at 479 ("It is appropriate to allow sufficient time to permit an orderly industry-wide transition").

[235] Under § 1910.1043(e)(1) of the standard, the employer must utilize engineering controls and work practices to meet the permissible exposure limits "except to the extent that the employer establishes that such controls are not feasible." 43 Fed. Reg. 27395 (1978). And under § 6(b)(6)(A), (B) of the Act, 29 U.S.C. § 655(b)(6)(A), (B) (1976), an em-

assures protection to workers during the implementation period with the standard's respirator provisions.[236] We cannot disturb the agency's decision simply because petitioners would have struck a different balance between the needs of employers and employees.[237] We find that the four-year period reflects reasoned decisionmaking on the basis of the rulemaking record.

B. *The Medical Transfer and Wage Guarantee Provisions* [238]

The standard includes special provisions for employees who, for medical reasons, cannot wear respirators. Sec-

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ployer may obtain a temporary variance from the requirements of the standard upon showing that

> (i) he is unable to comply with a standard by its effective date because of unavailability of professional or technical personnel or of materials and equipment needed to come into compliance with the standard or because necessary construction or alteration of facilities cannot be completed by the effective date, (ii) he is taking all available steps to safeguard his employees against the hazards covered by the standard, and (iii) he has an effective program for coming into compliance with the standard as quickly as practicable.

See Industrial Union, 499 F.2d at 479-80.

[236] 43 Fed. Reg. 27384; *id.* at 27396 (§ 1910.1043(f) (1978)). Employers will incur the cost of providing respirators to all exposed employees until compliance with the appropriate PEL is attained. *Id.* at 27385.

[237] *See* Industrial Union v. Hodgson, 499 F.2d at 479.

[238] The union petitioners in this case have not challenged what they consider inadequacy in the medical surveillance provisions in the standard, since OSHA "has expressly represented . . . that [it] will shortly address this matter, in light of the conclusions reached by the agency in the rulemaking proceedings regarding the lead standard." Union Br. at 29, n.80. The union petitioners thus receive two broader questions, neither of which is implicated by the medical transfer

tion 1910.1023(f)(2)(v) provides for the transfer of such employees to positions outside the dusty areas:

> Whenever a physician determines that an employee is unable to wear any form of respirator, . . . the employee shall be given the opportunity to transfer to another position which is available or which later becomes available having a dust level at or below the PEL.[239]

This section also guarantees the wages and benefits of transferred employees:

> The employer shall assure [that] an employee who is transferred due to an inability to wear a respirator suffers no loss of earning or other employment rights or benefits as a result of the transfer.[240]

The textile petitioners argue that this provision exceeds OSHA's statutory authority.[241] We find to the contrary that this provisions falls within the agency's authority to include in its standards such "practices, means, methods, operations, or processes, [that are] reasonably necessary or appropriate to provide safe or healthful employment."[242] OSHA determined that a limited number of employees cannot be protected even temporarily by res-

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and wage guarantee provisions of the cotton dust standard: (1) should employers be required to take certain personnel actions such as transferring employees to less dusty areas of a plant when medical reports show them to be at increased risk; and (2) should certain employer actions be prohibited, such as firing employees based upon information obtained pursuant to the medical surveillance program. *Id.*

[239] 43 Fed. Reg. 27396 (1978) (§ 1910.1043(f)(2)(v)).

[240] *Id.*

[241] Textile Brief at 67-71.

[242] Section 3(8) of the Act, 29 U.S.C. § 652(8) (1976).

pirators.[243] Absent the medical transfer and wage guarantee provisions, during the interim compliance period these employees would be forced to suffer continuing exposure to impermissibly high dust levels or else risk disadvantageous transfers, or even risk losing their jobs.[244] Given these alternatives, such employees may refrain from disclosing actual health impairments from the dust exposure. OSHA is authorized to guard against such problems. Its mandate is to assure that "*no* employee will suffer material impairment of health or functional capacity" on the job.[245] In light of the Act's purposes,[246] OSHA sought to avoid these problems and properly placed the cost of employee protection on the employer.

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[243] Due to the high incidence of diminished pulmonary function among existing cotton dust workers OSHA expects that some employees will be found to be incapable of wearing a single use or other form of negative pressure respirators. . . . [C]ertain employees will be incapable of even wearing a PAPR [powered air purifying respirator]. An employee under such circumstances, in the absence of some opportunity to transfer to a position where a respirator need not be worn, might very well be discharged, or otherwise sustain economic loss, due to his or her inability to wear a respirator.

43 Fed. Reg. 27387 (1978).

[244] *Id.*

[245] Section 6(b)(5) of the Act, 29 U.S.C. § 655(b)(5) (1976).

[246] The Act's overriding purpose is to "assure so far as possible every working man and woman in the nation safe and healthful working conditions." Section 2(b) of the Act, 29 U.S.C. § 651(b) 1979. *See also* Legis. Hist. at 1050-51 (remarks of Sen. Eagleton) (costs of health and safety standards are reasonable and necessary costs of doing business); *id.* at 1051 (remarks of Rep. Broomfield) (workers should not suffer while labor and industry argue);

Employers will be burdened for only a short time by the medical transfer and wage guarantee provisions. Once employers achieve the requisite exposure levels, no employees, to be protected, will need respirators or job transfers. In the meantime, the provisions provide a reasonable incentive for employers to speed compliance efforts. They also sensibly allocate the transfer decision to doctors surveying the individual workers. We find, therefore, that the medical transfer and wage guarantee provisions fall within OSHA's authority to adopt methods reasonably necessary to ensure safe working conditions.[247]

C. *Pulmonary Function Tables*

OSHA included as Appendix C to the standard a set of tables that establishes predicted pulmonary function values as the norm against which employees' actual lung functions are to be measured.[248] Under the standard's medical surveillance provisions, if an employee's actual lung function falls more than twenty percent below the appropriate value specified in these tables, the employee must be retested every six months until the table's values are met.[249]

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[247] Textile Petitioners also challenge the agency's choice of respirators expressed in § 1910.1043(f)(2), 43 Fed. Reg. 27396 (1978). OSHA points to expert testimony that supports its decision to require the more expensive, reusable respirators. As the record shows that less costly single-use respirators cannot be relied upon at such dust levels, whenever the time-weighted exposure level exceeds five times the prescribed level. J.A. 3604, OSHA's determination is adequately supported.

[248] 43 Fed. Reg. 27414-18 (1978) (based on F. Knudson, *et al., The Maximal Expiratory Flow-Volume Curve,* 113 AM. REV. RESPIRATORY 587 (1976)). *See* 43 Fed. Reg. 27391.

[249] 43 Fed. Reg. 27397 (1978) (§ 1910.1043(h)(2)).

The textile industry asks us to vacate these tables.[250] The industry claims that the tables and the studies on which they are based were not made part of the record and were not available for public comment before the promulgation of the final standard. Further, the industry claims that the tables rely on studies of a sample population that does not share important characteristics with the employees who will be measured against the tables.[251]

We find petitioners' claims unwarranted. This is not an instance of a final standard that contains a provision substantially different from the proposed version.[252] The proposed version contained similar tables and the agency explicitly solicited comments on their use.[253] There

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[250] Textile Brief at 64-67.

[251] Petitioners assert that "the Knudson tables were determined from the test results of 746 non-Mexican-American, non-smoking residents of Tuscon, Arizona, who were totally free of respiratory symptoms or diseases and had no history of heart trouble . . . . In stark contrast, over half of textile industry employees smoke heavily." Textile Br. at 67 183. (citations omitted). It remains unclear whether petitioners find the sample group unrepresentative beyond the fact that they are non-smokers. In any case, petitioner's challenge on this point must fail. OSHA reasonably selected a medical predictive index of established normal functioning levels that can be used to uniformly measure any and all variations.

[252] *Cf.* National Constructor's Ass'n v. Marshall, 381 F.2d 960, 966-67, 972 (D.C. Cir. 1978) (procedural defect where OSHA rule significantly differs in final form earlier version available to Advisory Committee).

[253] The agency requested comment on "whether . . . pulmonary functions measurement[s] need to be applied differently to different ethnic groups." 41 Fed. Reg. 56498 (1976), J.A. 171 (Statement Accompanying Proposed Standards). OSHA summarized the comments received on this point in the Statement Accompanying the Final Standard at 43 Fed. Reg. 27391 (1978).

is no doubt that the general concept of pulmonary function tables as benchmarks in medical surveillance was thoroughly discussed during the informal rulemaking proceeding.[254]

Petitioners still ask us to vacate the tables finally adopted because their exact form and contents were not available for comment during the rulemaking process. Were we to agree, we would essentially preclude the agency from responding to comments during the rulemaking process,[255] for the tables finally adopted were a logical outgrowth of testimony receiving during the rulemaking proceeding.[256] The sample population employed

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[254] *See, e.g.*, J.A. 1225-26 (Statement of Grover Wrenn); J.A. 1413-14 (Statement of Hans Weill); J.A. 1561-62 (Merchant Study); J.A. 3346-47 (posthearing comments of textile industry); J.A. 3463-64 (posthearing comments of textile workers union).

[255] *See* South Terminal Corp. v. EPA, 504 F.2d 646, 659 (1st Cir. 1974). Similarly,

> As we have previously held, the requirement of submission of a proposed rule for comment does not automatically generate a new opportunity for comment merely because the rule promulgated by the agency differs from the rule it proposed partly at least in response to submissions.[51]
>
> [51] A contrary rule would lead to the absurdity that in rulemaking under the APA the agency can learn from the comments on its proposals only at the peril of starting a new procedural round of commentary. [footnote in original].

International Harvester Co. v. Ruckelshaus, 478 F.2d 615, 632 & 632 n.51.

[256] The Knudson tables, adopted in the final standard, followed guidelines for measuring pulmonary function that were endorsed by both industry and OSHA representatives during the rulemaking proceedings. *See* J.A. 3349; 43 Fed. Reg. 27418 (1978) (Appendix D) (minimum standards for pulmonary functioning measurements).

improve the scientific reliability of these tables when compared with those used in the proposed standard.[257] Thus, we find the adoption of these tables consistent with the requirements of informal rulemaking and with the agency's duty to base the standard on the "best available evidence." [258]

CONCLUSION

Our task on review has not been easy. The record is massive and unwieldy; [259] it reveals numerous medical and technical issues in need of continued study. Congress, however, has made it clear that OSHA must protect every worker from the risks of material health impairment due to occupational exposure to hazardous materials. OSHA

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[257] See 43 Fed. Reg. 27391 (1978). The Knudson tables were based on studies of males and females. The tables used in the proposed standard instead used data from 15 years earlier on only male subjects and relied on estimates to derive a full range of values. *Id.*

[258] *See* Section 6(b)(5) of the Act, 29 U.S.C. § 655(b)(5) (1976).

[259] As a constructive criticism, we offer one further observation. Although the agency amassed an impressive array of experts and assembled comments from workers, employers, scientists, and economists, the agency did not present the evidence in a fashion easily amenable to review.

Our review function would have been greatly facilitated if OSHA had organized the material in the rulemaking record in some logical fashion. A more systematic identification of the topics of different pieces of testimony, the comments that pertain to particular studies, and the questions that remained unanswered by the proceedings would have eased our task on review and also presented the agency's case more forcefully.

Thus, although we are satisfied that the agency met its burden on review except for the application of the standard to the cottonseed oil industry, we reach that conclusion only after a tedious and at times frustrating review of the record.

is constrained only by the requirement that its standards be technologically and economically feasible for the regulated industries. In sum, our review leads us to uphold the standard, except for its application to the cottonseed oil industry. In every aspect except that one, OSHA explained the evidence in the record it found persuasive and the policies that guided its judgment when facts proved insufficient. As for the cottonseed oil industry, however, we are unable to discern the basis for the agency's feasibility determination. We do not conclude that the standard is infeasibile for that industry; rather, we remand that portion for reconsideration or clarification by the agency.

Ordinarily, we would remove the stay of the standard that was granted for the pendency of this litigation. In view of the alleged magnitude of the consequences, however, we will defer action regarding the stay to afford petitioners 20 days to show cause why the stay should not be lifted.

It is so ordered.

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

Filed January 11, 1980

No. 78-1562 September Term, 1979

AMERICAN FEDERATION OF LABOR & CONGRESS OF INDUSTRIAL ORGANIZATIONS, ET AL.,

Petitioners

V.

RAY MARSHALL, SECRETARY OF LABOR, UNITED STATES DEPARTMENT OF LABOR, ET AL.,

Respondents

And Consolidated Case Nos. 78-1736, 78-1979, 78-1980, 78-1981, 78-1982, 78-1983, 78-1984, 78-1986, 78-1987, 78-1988, 78-1989, 78-1990, 78-1991, 78-1992, 78-1993, 78-2013, 78-2014, 78-2016, and 78-2018.

BEFORE: Bazelon, Senior Circuit Judge; Tamm and Robinson, Circuit Judges

ORDER

Upon consideration of the petitions for rehearing submitted by the various parties, it is

ORDERED, by the Court, that the aforesaid petitions for rehearing are denied.

Per Curiam
For the Court:

George A. Fisher, Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

Filed January 11, 1980

No. 78-1562 September Term, 1979

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BEFORE: Wright, Chief Judge; McGowan, Tamm, Robinson, MacKinnon, Robb, Wilkey, Wald and Mikva, Circuit Judges

ORDER

Suggestions for rehearing *en banc* submitted by various parties to these proceedings, having been transmitted to the full Court and no judge in regular active service having requested a vote with respect thereto, it is

ORDERED, by the Court, *en banc*, that all suggestions for rehearing *en banc* are denied.

Per Curiam

For the Court:
George A. Fisher, Clerk

Statement of Circuit Judge MacKinnon:

The Supreme Court in October heard oral argument in *Marshall* v. *American Petroleum Institute*, No. 78-1036, on the question whether a cost benefit analysis was required in a relatively comparable case. Judge MacKinnon would defer *en banc* consideration of this opinion until the Supreme Court issues its opinion in *Marshall* v. *American Petroleum Institute*.

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

Filed January 22, 1980

No. 78-1562 September Term, 1979

AMERICAN FEDERATION OF LABOR &
CONGRESS OF INDUSTRIAL ORGANIZATIONS,
Petitioner

v.

RAY MARSHALL, SECRETARY OF LABOR,
UNITED STATES DEPARTMENT OF LABOR,
ET AL.,
Respondent

And Consolidated Case Nos. 78-1736, 78-1979, 78-1980, 78-1981, 78-1982, 78-1983, 78-1984, 78-1986, 78-1987, 78-1988, 78-1989, 78-1990, 78-1991, 78-1992, 78-1993, 78-2013, 78-2014, 78-2016 and 78-2018

BEFORE: Bazelon, Senior Circuit Judge; Tamm and Robinson, Circuit Judges

ORDER

Upon consideration of the motions of petitioners National Cotton Council of America, Cotton Warehouse Associations, et al and American Textile Manufacturers Institute, Inc., et al for stay of the issuance of the mandate, and of the responses thereto filed by respondents and by petitioner unions, it is

ORDERED, by the Court, that the aforementioned motions to stay issuance of the mandate in the captioned case,

and in all of the cases consolidated therewith, except for Appeal No. 78-2014, are denied and the Clerk is directed to issue the mandate forthwith in all of the above-referenced cases, excepting only Appeal No. 78-2014. Provisions relating to the stay of the standard for exposure to cotton dust and to the effective date of that standard, as set forth in an order of the Court filed January 11, 1980, are not affected by the instant order.

Per Curiam
For the Court:

George A. Fisher, Clerk

Circuit Judge Tamm voted to stay issuance of the mandate for 30 days.

Exhibit 6, No. 18

BYSSINOSIS

A Study of 10,133 Textile Workers

Harold R. Imbus, MD, ScD, and
Moon W. Suh, PhD, Greensboro, NC

All charts at end of article

A respiratory screening program, including the administration of a questionnaire and pulmonary function tests, including one-second forced expiratory volume (FEV_1), and forced vital capacity (FVC), was carried out on employees working in cotton textile plants. This identified employees with byssinosis and other pulmonary conditions. The results revealed a marked relationship between the incidence of byssinosis and bronchitis and between byssinosis and lowered pulmonary function. Cigarette smoking appeared to further increase the incidence of bronchitis and lower pulmonary function. A drop in FEV_1 during the working day, though associated with, was often present without byssinosis symptoms. A combined program of dust control with medical evaluation and surveillance is practical. Identification of reactors to cotton dust and those with other pulmonary conditions enables the employer to lessen risk by localization of areas in need of improved environmental control and by selective placement of employees.

In 1970, Duke University and the North Carolina State Board of Health cooperated with Burlington Industries in

Submitted for publication June 20, 1972; accepted Oct. 31.

From the Medical Department, Burlington Industries, Inc., Greensboro, NC.

Reprint requests to Burlington Industries, Inc., Medical Department, 3330 W. Friendly Ave., Greensboro, NC 27420. (Dr. Imbus).

a study of byssinosis to determine prevalence and control measures, and to evaluate various dust sampling techniques. Preliminary results of these studies have been presented by Merchant[1] and Lumsden.[2] As a result of their findings and recommendations a cooperative study in environmental control possibilities was embarked upon, and a corporate-wide preventive medical control program aimed at identifying and evaluating those persons with all forms of chronic lung disease was started. The results of the surveys initiated in the medical control program are presented in this paper.

Altogether 10,133 employees of Burlington Industries in 19 plants participated in the initial survey of the project. The selected plants process raw cotton in the manufacture of yarn. All employees, including unexposed employees, were invited to participate in those plants included in the program. Though participation was voluntary, over 95% of employees took part. Though the primary purpose of the project was to institute a preventive program, the large number of employees screened provided enough data for a unique opportunity to evaluate a number of interesting relationships. Some of these are presented below.

Method

The medical study program consisted of the following:

Respiratory Questionnaire.—The British Medical Research Council Respiratory Questionnaire modified by Schilling, Merchant, and Kilburn was administered to each employee participating in the study. This consists of 115 questions designed to highlight the existence of clinical bronchitis or byssinosis or both in addition to allergy, smoking history, and work history, especially including years of work with cotton.

Pulmonary Function.—Forced vital capacity (FVC) and

one-second forced expiratory volume (FEV_1), before the beginning of the work shift on the first day of the work week and repeated approximately six hours into the work shift were obtained on each employee. Follow-up pulmonary function studies, physician interview, chest x-ray films, and detailed clinical studies followed if indicated by questionnaire or abnormal test results. On new employees, initial base line FEV_1, FVC, and questionnaire results were obtained and were again obtained within six weeks of employment.

A minimum of four forced exhalations were obtained from each subject during each testing. The instrument used was a waterless spirometer (Jones Pulmonor II) set on 1 in/sec speed. Graphs were read by trained technicians. The highest two FEV_1 and FVC findings were averaged and represented the observed FEV_1 and FVC for each individual.

Calculations were made for each of the following:

$$\text{Predicted } FEV_1{}^{3} \text{ (and unpublished data)} = FEV_1\,(P)$$

$$\text{Percent of predicted } FEV_1 = \frac{FEV_1 \text{ observed}}{FEV_1\,(P)} \times 100 = FEV_1\,(P)\,\%$$

$$\text{Change in } FEV_1 = FEV_1 \text{ after six hours work} - FEV_1 \text{ before work} = \triangle FEV_1$$

$$\text{Percent change in } FEV_1 = \frac{\triangle FEV_1}{FEV_1 \text{ before work}} \times 100 = \%\ \triangle FEV_1$$

Data Processing.—Byssinosis was graded according to the classification of Schilling[4] as follows: grade 1/2, occasional chest tightness or cough on the first day of the work week; grade 1, chest tightness on every first day of the work week; grade 2, chest tightness on the first and other days of the working week.

Since our analyses relate byssinosis symptoms (all grades) to pulmonary function findings, grade 3 (which is grade 2 symptoms accompanied by evidence of permanent

respiratory impairment) is omitted from the following tables.

Chronic bronchitis was defined and graded as follows: grade 0, no evidence of the production of sputum from the chest of such frequency as graded below; grade 1, simple chronic bronchitis. Evidence of the production of sputum from the chest first thing in the morning—or upon rising, on most days for a period of at least three months each year for at least the past two years, and the absence of an exacerbation as defined below; grade II, chronic bronchitis with an exacerbation. Evidence of the presence of sputum as defined in grade 1 above together with one or more periods of increased production of sputum lasting three weeks or more within the past three years, or, one or more chest illnesses with an increased production of sputum causing an absence from work for at least one week during the past three years.

Smokers are defined as those who now smoke or have smoked one cigarette or more per day for as long as one year, exclusive of pipe smokers. All data from questionnaire and pulmonary function measurements were keypunched and processed by computer. A printout for each subject was obtained including such data as byssinosis and bronchitis grade, pulmonary function measurements, area of work, change in FEV_1, etc.

A team of four nurses, a physician's assistant, and plant nurses in each involved plant were trained in the interview technique and in the interpretation of the pulmonary function measurements in a one-day seminar. During the surveys, those trained also received several hours of personal supervision on-site during the surveys by the medical director or the chief nurse, until proficiency was demonstrated. The medical director or chief nurse or both visited

each plant during the time of its survey and personally observed each team member in the performance of interview and pulmonary function testing in order to reduce observer variation.

Recommendations were made to management and employees for suitable work change where indicated. A yearly retesting program has been instituted.

Results

Due to practical considerations, a number of employees working in relatively nondusty areas was tested only before the work shift; this left a total of 8,025 of the 10,133 employees who participated in both sets of pulmonary function tests. Results of questionnaire data, including subjective byssinosis symptoms, bronchitis, and smoking history, are based upon the larger number, whereas activities necessitating before and after pulmonary function tests are based upon the smaller number. Results necessitating only single pulmonary function determination, eg, percent predicted FEV_1, are based upon the number of observations available for that determination. A summary of results is shown in Table 1. The incidence of byssinosis (all grades) by length of employment is shown in Table 2. Table 2 shows males tend to have a higher incidence the longer employed, whereas females vary little with length of employment. Tables 3 and 4 show incidence of byssinosis and bronchitis by age, sex, and smoking habits. Further analysis to separate the effect of smoking and length of employment was not considered feasible due to the small number of individuals who would be present in each of the multiple cells required for this analysis.

Byssinosis by Work Area.—Our findings (Fig. 1) as expected revealed the highest incidence of byssinosis in

preparation areas (opening, blending, picking, carding, drawing, combing, roving) with a much lower incidence in other areas (spinning, winding, twisting, spooling, slashing, weaving, and miscellaneous areas). The very low incidence in areas other than preparation is possibly due to the better grade of cotton and high percentage of synthetic mixture used in most of the plants surveyed.

Byssinosis, Bronchitis, and Smoking.—In order to determine the degree of association, if any, between byssinosis and bronchitis, the total population was partitioned into combinations of byssinosis grades (0, 1/2, 1, 2) and bronchitis grades (0, 1, 2). Based on the number of observations in each cell and the marginal total for each grade, tests were made to see if the two diseases occur independently of each other. The same tests were also made after combining the disease grades greater than zero.

Tables 5 and 6 show the observed values and the expected value obtained under the independency assumption for male and female populations, respectively. It can be seen from these tables that there is a strong association between occurrence of byssinosis and bronchitis with higher grades of byssinosis associated with increasing incidence of bronchitis, and vice versa. Males who smoke have a significantly higher incidence of byssinosis than those who don't, whereas there is no difference between females who smoke and those who don't as seen in the following data:

	Male		Female	
P (BY/NS)	= 3.7%	s	3.1%	ns
P (BY/S)	= 6.2%		2.9%	

where s = the difference is statistically "significant" at 5% error level. ns = the difference is statistically "not significant" at 5% error level. BY=byssinotic. S=smoking. NS=nonsmoking. P (BY/NS)= percentage of byssi-

notics (grades 1/2, 1, or 2) among nonsmokers disregarding bronchitis status. P (BY/S)=percentage of byssinotics among smokers.
The reason for this is unclear.

The relative incidence of bronchitis among those with and without byssinosis was as follows:

	Male		Female	
P (BR/NBY.NS)	5.3%	s	3.9%	s
P (BR/NBY.S)	12.5%		7.5%	
P (BR/BY.NS)	33.3%	s	18.3%	s
P (BR/BY.S)	41.9%		36.7%	

where s = the difference is statistically significant at 5% error level. BR = bronchitis. P (BR/NBY.NS) = percentage of bronchitics among nonbyssinotic nonsmokers. P (BR/NBY.S)=percentage of bronchitics among nonbyssinotic smokers. P (BR/BY.NS)=percentage of bronchitics among byssinotic nonsmokers. P (BR/BY.S) = percentage of bronchitics among byssinotic smokers.

Byssinosis clearly is associated with clinical chronic bronchitis and smoking is clearly associated with increased incidence of bronchitis among byssinotics and nonbyssinotics. Further analysis (not shown) revealed a definite positive association between the incidence of byssinosis, bronchitis, and the number of packs of cigarettes smoked per year.

Byssinosis, Bronchitis-Predicted Pulmonary Function.—Each employee's percentages of predicted FEV_1 and FVC were calculated. These were averaged for various categories: age, sex, and department in the plant; as well as for byssinotics, nonbyssinotics, bronchitics, and nonbronchitics in smoking and nonsmoking males and females. Table 7 shows the averages of the predicted values of FEV_1 for smokers and nonsmokers with and without byssinosis and bronchitis. It is seen from the table that nonbyssinotic, non-

bronchitic, nonsmokers had the highest average predicted FEV_1 in both male and female categories. Among nonsmokers, a mild though definite decrease is noted in those who have bronchitis without byssinosis, a more marked decrease in those with byssinosis without bronchitis, and in males the lowest value is obtained for byssinotics with bronchitis. In females, the slightly higher value of byssinosis with bronchitis may be spurious due to the small sample size. Corresponding similar decreases are noted for smokers with the exception that there is very little difference between nonbyssinotic bronchitics, and byssinotic nonbronchitics among the male smokers, possibly due to compound effects of smoking and the two diseases. Smokers, however, are significantly lower in every category with the exception of nonbronchitic, byssinotic females. Figure 2 illustrates the lowering of FEV_1 (P)% for bronchitics, byssinotics, and combined conditions, and the additional lowering from smoking as compared with base line values of nonbronchitic, nonbyssinotic nonsmokers. These differences were estimated by using the least squares method based on a linear additive statistical model in which the effects of sex, smoking, byssinosis, and bronchitics are properly represented. Table 8 reveals the average percentage of predicted FVC determinations for the corresponding categories. Though similar associations are noted in some cases, FVC predicted values are much more nearly normal and less likely to fluctuate according to the categories, indicating that pathological changes observed here are more likely to affect flow rate rather than vital capacity.

Of interest is the fact that the predicted values for FEV_1 and FVC never average 100% which theoretically they should in a normal population. Control studies on employees unexposed to cotton dust revealed no employee groups

averaged much higher than 90% of predicted values. A combination of several factors may explain this phenomenon: (1) No attempt was made to remove unsatisfactory graphs of poor performers. (2) Employees with all types of pulmonary disease plus cardiovascular disease were included; thus an employee listed as nonbronchitic, nonbyssinotic may have other diseases resulting in abnormally low results. (3) To facilitate testing, the height of employees—except for women in high heels—was measured with shoes on, thus resulting in a slight overprediction. (4) There is evidence from data of asymptomatic nonsmoking employees that present prediction formulae tend to overpredict for some age groups. Regression formulae developed from asymptomatic employees revealed considerably lower predicted values than would be expected from the Veterans Administration cooperative study.

Average percentage of predicted FEV_1 was determined in relation to length of employment in cotton mills. Figure 3 reveals that FEV_1 (P)% does not tend to decrease with increased length of employment in nonsmoking, nonbyssinotic males, whereas in nonsmoking byssinotic males it begins to drop off sharply after about 18 years of employment. Nonbyssinotic smokers always have a lower FEV_1 which tends to become increasingly lower with time. The values for smoking byssinotics are much lower than those for nonsmoking byssinotics for approximately 20 years; then the difference narrows.

There is a gradual drop of pulmonary function in nonbyssinotic, nonsmoking females (Fig. 4), which may be related to the tendency of current prediction formulae to overpredict with older females. There would have been no age effect had the formulae been obtained without bias.

The pulmonary function of byssinotic female smokers

and nonsmokers tends to be lower than that of nonbyssinotics even in the beginning of their employment. The reason for this is not understood since byssinosis would be expected to take years to produce respiratory impairment. The rather small number of byssinotic females makes trends much more difficult to distinguish. However, it is interesting to conjecture as follows: Females are generally exposed to lower concentrations of dust than males because their jobs more frequently place them in less dusty areas like spinning, winding, and weaving while the more dusty opening, picking, and carding jobs are largely staffed by males. Perhaps those males with diminished pulmonary reserve at the time of employment select themselves out rather quickly upon developing byssinosis because of obvious relationship to work. Symptoms in females frequently appeared to be much milder, more subtle, and less obviously related to work, making it less likely that those with preexisting disease would leave. The observation that of female byssinotics 72% are in grade 1/2, and 28% are in grades 1 and 2, while of males 57% are in grade 1/2 and 43% in grades 1 and 2 tends to support this conjecture.

Figures 3 and 4 clearly show that smoking employees, byssinotic employees, and smoking, byssinotic employees in the order mentioned are at increasing risk of developing respiratory impairment, as compared with nonsmoking, nonbyssinotic employees. However, the question arises, are those exposed to cotton dust without byssinosis also at some degree of risk of developing impairment over a number of years of exposure? In order to answer this question, it would be necessary to compute FEV_1 (P)% by length of employment for the above categories for several levels of dustiness. Even with the large number included in this study, a breakdown into so many categories would not yield

large enough numbers per category to provide meaningful results.

Byssinosis and Change in Δ FEV_1.—Much interest has been shown recently in obtaining FEV_1 and FVC before and during the work shift as a measure of reactivity to cotton dust. Bouhuys et al[5] proposed functional classification of byssinosis based upon FEV_1 change after working. It is seen (Table 9) that both bronchitis without byssinosis and byssinosis without bronchitis produce decrement of FEV_1 during the working day, with byssinosis generally producing a larger decrement, especially in males. A combination of both conditions, however, results in the greatest decrement. There is lack of association of cigarette smoking with decrement during the working day as Zuskin et al[6] also reported. In order to better examine the possible effect of smoking, all FEV_1 data were adjusted with use of the prediction formula to bases of males and females aged 40, thus enabling us to deal with absolute decrement in cubic centimeters instead of percentages. No adjustment was made for height due to insignificant differences among the group averages. Figures 5 and 6 show the average values of the adjusted FEV_1 readings before and during work. It is apparent that smoking has very little effect upon decrement but that all readings are significantly decreased in smokers. Based on the group averages, byssinosis does not appear to produce greater decrements than bronchitis but the combination of both conditions produces the greatest. Obviously, the decrement is valuable in determining reactivity, but the clinical and prognostic significance of the decrement as it occurs in an individual without symptoms of byssinosis is open to speculation. One might ask, does the reactivity produce chronic lung disease or does reactivity result from it? Certainly more detailed studies would be necessary to

clarify this point. It should be pointed out in Fig. 5 and 6 that the age adjustment was carried out by use of the linear correction terms for age given in the Veterans Administration prediction formulae[7] (and unpublished data). Since the adjustment factors are linear, neither the FEV_1 decrements (slopes) after work nor the gaps between smokers and nonsmokers will be affected by selecting a base age different from 40. It will simply shift the entire graph upward or downward to provide the group averages corresponding to the new base age.

Those with a decrement of greater than 10% with and without symptomatic byssinosis had lower than average percentage predicted FEV_1 (Table 10). Those with combinations of byssinosis symptoms and decrement greater than 10% were lowest of all. Of interest is the observation that only approximately 25% of byssinotics showed a decrement of 10% or more, whereas only approximately 7% of those with decrements of 10% had byssinotic symptoms. Similar comparisons were made based on 15%, 20%, and 25% decreases in FEV_1 but the probabilities of correct discrimination did not improve significantly. The clinical and prognostic significance of FEV_1 findings needs further study.

The % Δ FEV_1 by work area was as follows: preparation, 3.9%; yarn production, 1.5%; slashing/weaving, 1.5%; and miscellaneous, 1.0%. As expected, greater decrements in FEV_1 are associated with the more dusty areas.

Comment

This screening program involving 10,133 employees has revealed that such programs are practical and effective in identifying byssinotic employees and those with pulmonary impairment. These findings are in agreement with those of

others; there is a high association between the incidence of byssinosis and bronchitis[8], and both conditions are associated with lower pulmonary function.[9,10] Smoking is associated with an additional increased incidence of bronchitis and further impairment of pulmonary function. This study reveals no evidence that nonbyssinotic, nonsmoking males show any deterioration of pulmonary function during prolonged work in cotton plants nor does it prove that they don't. The picture is less clear in females, who show a gradual decrease in percentage of predicted pulmonary function. This may be due to overprediction for the older age groups. Decrement of FEV_1 during the working day is associated with byssinosis, but also with bronchitis, and perhaps other pulmonary disease, and appears to be nonspecific for byssinosis, since only a small percentage of those showing this decrement also have symptoms of byssinosis. Smoking, although associated with lower overall FEV_1, was not associated with greater decrements of FEV_1 during the working day.

Of particular interest is the relatively small number of individuals who have both byssinotic symptoms and decrement in FEV_1 during the working day. Bouhuys et al have proposed a functional grading system[10] which is the basis for a scheme of work assignment developed later.[11] We found considerable numbers of employees exhibiting decrement in FEV_1 without either evidence of symptoms or respiratory impairment. Therefore, care should be exercised in assuming that any one individual exhibiting this phenomenon is at risk. On the other hand, the fact that the group with the decrement have lower percent of predicted FEV_1 indicates that this reactivity may result in or result from pulmonary impairment. Therefore, this group deserves close surveillance and placement in as low a dust exposure as is practical.

Management and employee acceptance of this program was excellent. Of particular value in obtaining cooperation were thorough explanations to these groups of the nature and benefits of the program. Logistics of scheduling and testing large numbers of employees before and during shift, while the plant is at full production, are complex; however, these activities proceeded very smoothly due to detailed planning in each plant. Details of planning, interviewing, and testing are described elsewhere.[12]

Dust samples were obtained with a vertical Lynch Lumsden elutriator cotton dust sampler[13] during screening in each plant. Linear correlations between dustiness, incidence of byssinosis, and decrement in FEV_1 were apparent. Since only identification of relative dustiness was the purpose and since certain practical considerations dictated relatively small numbers of dust samples in each area, these data are not presented.

Screening programs are only as good as the follow-up of positive results. Those showing significant decrement in FEV_1 and an abnormally low FEV_1, according to criteria proposed by the organizing committee, National Conference on Cotton Dust and Health,[11] had pulmonary function measurements repeated. Persons who presented positive results and those with symptoms of byssinosis were interviewed by the author, after which recommendations for placement or for comprehensive medical evaluation were made. Physicians knowledgeable in byssinosis performed a complete medical evaluation, including detailed ventilatory studies and measurement of arterial blood gas levels. Recommendations based on results of these studies were given to employees, employees' physicians, and management and where necessary the employee was transferred to work involving minimal dust exposure.

Medical surveillance programs of this type are only an

adjunct to, not a substitute for, environmental controls. Burlington Industries, Inc. is involved in a number of environmental control programs, including installation of exhaust systems, close coordination with machinery manufacturers, and cooperative research with Duke University and the North Carolina State Board of Health in development of pretreatment of cotton to reduce offending agents. A continuing program of environmental monitoring is being planned. Even so, it is generally agreed that any currently proposed methods of environmental control will not be completely effective. Therefore, the need for medical surveillance will probably continue for some time.

In spite of rapidly increasing interest, research, and considerable progress in recent years, knowledge of byssinosis is still very incomplete. It is our hope that programs, like that outlined above, may contribute to that knowledge, but even more important, provide protection to employees until complete control is available.

The British Medical Research Council Respiratory Questionnaire as modified by Schilling et al may be obtained from ASIS, National Auxiliary Publications Service, c/o CCMC Information Corp. 866 Third Ave. New York 10022.

REFERENCES

1. Merchant JA: Byssinosis prevalance. Read before the American Industrial Health Conference. Atlanta. 1971.

2. Lumsden JC: Environmental aspects of byssinosis. Read before the American Industrial Health Conference. Atlanta. 1971.

3. Boren HC. Kory RC, Snyder JC: The Veterans Administration cooperative study of pulmonary function: II. The lung volume and its subdivisions in normal men. *Am J Med* 41:96-114. 1966.

4. Schilling RSF, et al: A report on a conference on byssinosis. *Proc XIV Int Congr Occup Health, Madrid* 2:137-145, 1963. Exercpta Medica, Amsterdam.

5. Bouhuys A. et al: Byssinosis in hemp workers. *Arch Environ Health* 14:533-544, 1967.

6. Zuskin E. et al: Byssinosis in carding and spinning workers. *Arch Environ Health* 19:666-673, 1969.

7. Merchant JA, et al: Byssinosis and chronic bronchitis among cotton textile workers. *Am Int Med* 76:423-433, 1972.

8. Elwood DC, et al: Byssinosis and other respiratory symptoms in flax workers in Northern Ireland. *Br J Ind Med* 27:37, 1965.

9. Bouhuys A, et al: Byssinosis in the United States. *N Engl J Med* 17:170-175. 1967.

10. Valic, et al: Byssinosis, chronic bronchitis, and ventilatory capacities in workers exposed to soft hemp dust. *Br J Med* 25:176-186, 1968.

11. The status of byssinosis in the United States: A summary of the National Conference on Cotton Dust and Health and the recommendation of the organizing committee. *Arch Environ Health,* 23: 230-234, 1971.

12. Murphy AJ: A respiratory screening and surveillance program in a textile industry. Occup Health Nurs 20:12-15, 1972.

13. Lynch JR: Air sampling for cotton dust, in *Transactions of the National Conference of Cotton Dust and Health.* Chapel Hill, NC, University of North Carolina, 1970.

Table 1.—Byssinosis Survey	
Total employees surveyed (questionnaire)	10,133
Males	60.0%
Females	40.0%
Byssinosis (all grades)	4.6%
Males	5.7%
Females	3.0%
Bronchitis	9.8%
Males	12.6%
Females	6.0%
Smokers	64.0%
Males, smokers	78.0%
Females, smokers	43.0%
Total employees surveyed (questionnaire plus before and after pulmonary function)	8,206

Table 2.—Prevalence (%) of Byssinosis According to Length of Employment

	Length of Employment (Years) in Cotton Mills					
	0-8	8-16	16-24	24-32	32-40	40-48
Male	4.1	5.9	8.5	7.6	6.6	8.1
Female	3.1	3.1	3.4	3.4	1.9	2.1

Table 3.—Byssinosis Prevalence (%) for Different Age Groups and Smoking Habit

	Age Groups				
	Less Than 30	30-39	40-49	50 and Over	Total
Male					
Nonsmokers	2.5	3.0	5.9	5.2	3.7
Smokers	4.6	4.2	7.5	8.0	6.2
Combined total	3.9	4.0	7.2	7.5	5.7
Female					
Nonsmokers	2.9	3.8	2.7	3.2	3.1
Smokers	2.5	2.6	4.7	1.4	2.9
Combined total	2.7	3.2	3.6	2.7	3.0

Table 4.—Bronchitis Prevalence (%) for Different Age Groups and Smoking Habit

	Age Groups				
	Less Than 30	30-39	40-49	50 and Over	Total
Male					
Nonsmokers	4.9	4.7	9.1	8.4	6.3
Smokers	11.2	14.2	14.4	17.0	14.3
Combined total	9.2	12.3	13.6	15.4	12.6
Female					
Nonsmokers	3.1	4.1	4.4	5.1	4.3
Smokers	6.6	9.1	10.0	7.5	8.3
Combined total	4.7	6.6	6.9	5.8	6.0

Table 5.—Byssinosis vs Bronchitis in Men*

Bronchitis	Grades	Byssinosis 0	1/2	1	2	Total
	0	5,035 (4,933)	114 (153)	63 (93)	24 (51)	5,236
	1	419 (472)	33 (14)	24 (9)	18 (5)	500
	2	195 (238)	22 (7)	19 (5)	16 (2)	252
	Total	5,649	175	106	58	5,988

Bronchitis	Grades	Byssinosis 0	1/2+1+2	Total
	0	5,035 (4,933)	201 (297)	5,236 = 87.4%
	1+2	614 (710)	138 (42)	752 = 12.6%
	Total	5,649 = 94.3%	339 = 5.7%	5,988 = 100%

*Parenthetical numbers = expected values, ie, obtained under the assumption that the two diseases are occurring independently of each other.

Table 6.—Byssinosis vs Bronchitis in Women*

Bronchitis	Grades	Byssinosis 0	1/2	1	2	Total
	0	3,636 (3,612)	64 (76)	18 (26)	7 (11)	3,725
	1	110 (120)	10 (3)	3 (1)	1 (0)	124
	2	98 (112)	7 (2)	6 (1)	4 (0)	115
	Total	3,844	81	27	12	3,964

Bronchitis	Grades	Byssinosis 0	1/2+1+2	Total
	0	3,636 (3,612)	89 (113)	3,725 = 94.0%
	1+2	208 (232)	31 (7)	239 = 6.0%
	Total	3,844 = 97.0%	120 = 3.0%	3,964 = 100%

*See Table 5 footnote.

Table 7.—Average Percentage of Predicted FEV, in Smokers and Nonsmokers With and Without Byssinosis and Bronchitis

		Average % of Predicted FEV, Nonbyssinotic	Sample Size, Byssinotic
Male nonsmoker	Nonbronchitics	82.4 (993)	84.5 (28)
	Bronchitics	83.2 (50)	80.1 (16)
Male smoker	Nonbronchitics	85.9 (3,172)	81.5 (157)
	Bronchitics	81.2 (434)	73.7 (100)
Female nonsmoker	Nonbronchitics	85.7 (1,720)	76.6 (47)
	Bronchitics	82.9 (68)	78.4 (11)
Female smoker	Nonbronchitics	82.6 (1,213)	77.0 (30)
	Bronchitics	81.3 (93)	73.5 (15)

Table 8.—Average Percentage of Predicted FVC in Smokers and Nonsmokers With and Without Byssinosis and Bronchitis

		Average % of Predicted FVC, Nonbyssinotic	Sample Size, Byssinotic
Male nonsmoker	Nonbronchitic	91.7 (993)	99.9 (28)
	Bronchitic	93.4 (59)	85.4 (15)
Male smoker	Nonbronchitic	91.5 (3,172)	90.2 (157)
	Bronchitic	88.7 (484)	83.5 (109)
Female nonsmoker	Nonbronchitic	94.0 (1,729)	85.1 (47)
	Bronchitic	93.1 (68)	90.8 (11)
Female smoker	Nonbronchitic	93.4 (1,213)	87.1 (30)
	Bronchitic	95.4 (93)	87.7 (15)

Table 9.—Observed Percent Change in FEV in Smokers and Nonsmokers With and Without Byssinosis and Bronchitis

		Percent Change in FEV$_1$, Nonbyssinotic	Sample Size, Byssinotic
Male nonsmoker	Nonbronchitic	−0.3 (993)	−5.2 (28)
	Bronchitic	−3.8 (59)	−11.1 (15)
Male smoker	Nonbronchitic	−1.3 (3,157)	−4.7 (157)
	Bronchitic	−0.5 (484)	−6.9 (109)
Female nonsmoker	Nonbronchitic	0.4 (1,729)	−3.2 (47)
	Bronchitic	−3.3 (68)	−6.0 (11)
Female smoker	Nonbronchitic	−2.7 (1,213)	−3.1 (30)
	Bronchitic	−1.5 (93)	−2.9 (15)

Table 10.—Average Percent of Predicted FEV$_1$ vs Byssinosis and Decrement in FEV$_1$

	Percent Drop <10%		Percent Drop >10%	
	No. Observed	Av % Predicted FEV	No. Observed	Av % Predicted FEV$_1$
Nonbyssinotic	(6,410)	86.4	(1,384)	82.3
Byssinotic (all grades)	(302)	81.1	(110)	71.3

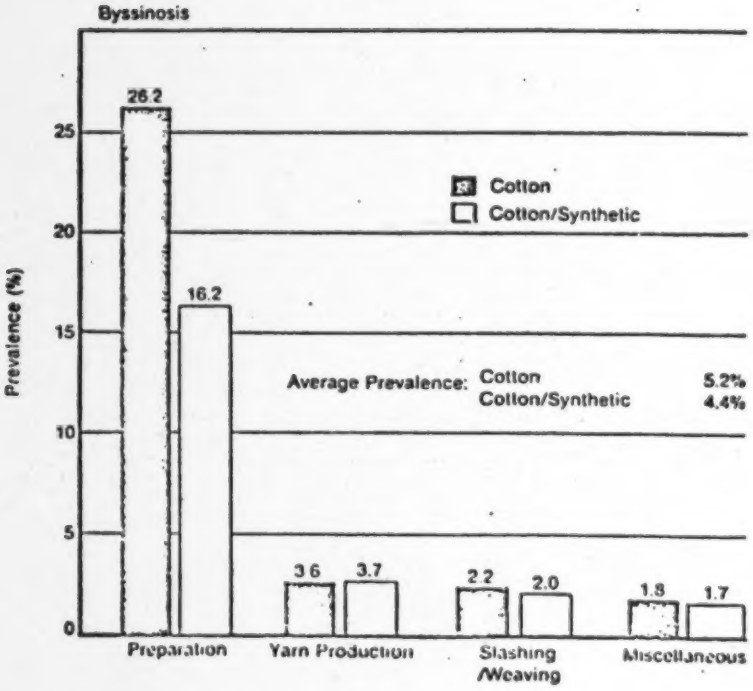


Fig. 1—Byssinosis prevalence by work area and raw material use.

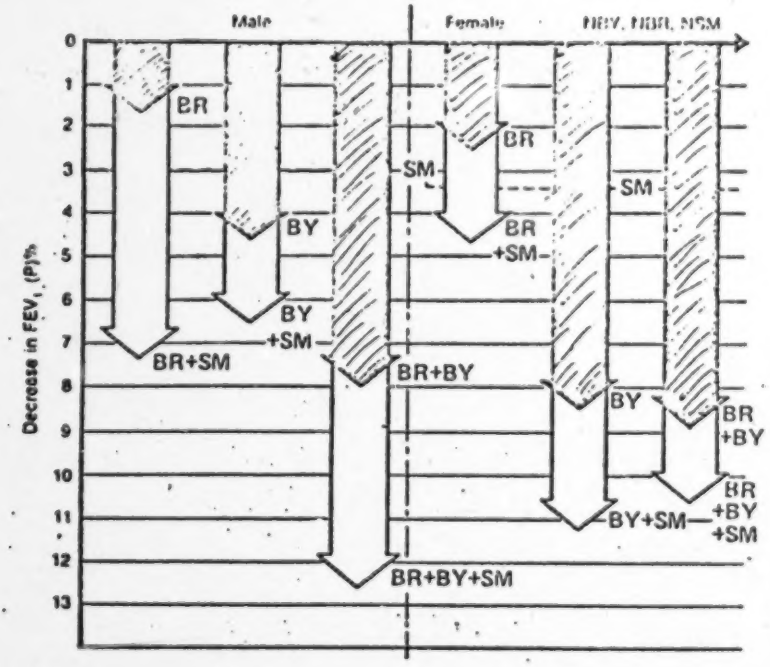


Fig. 2—Lower FEV_1 (P) % associated with byssinosis, bronchitis, and smoking in comparison to FEV_1 (P) % of nonbyssinotic, nonbronchiac nonsmokers.

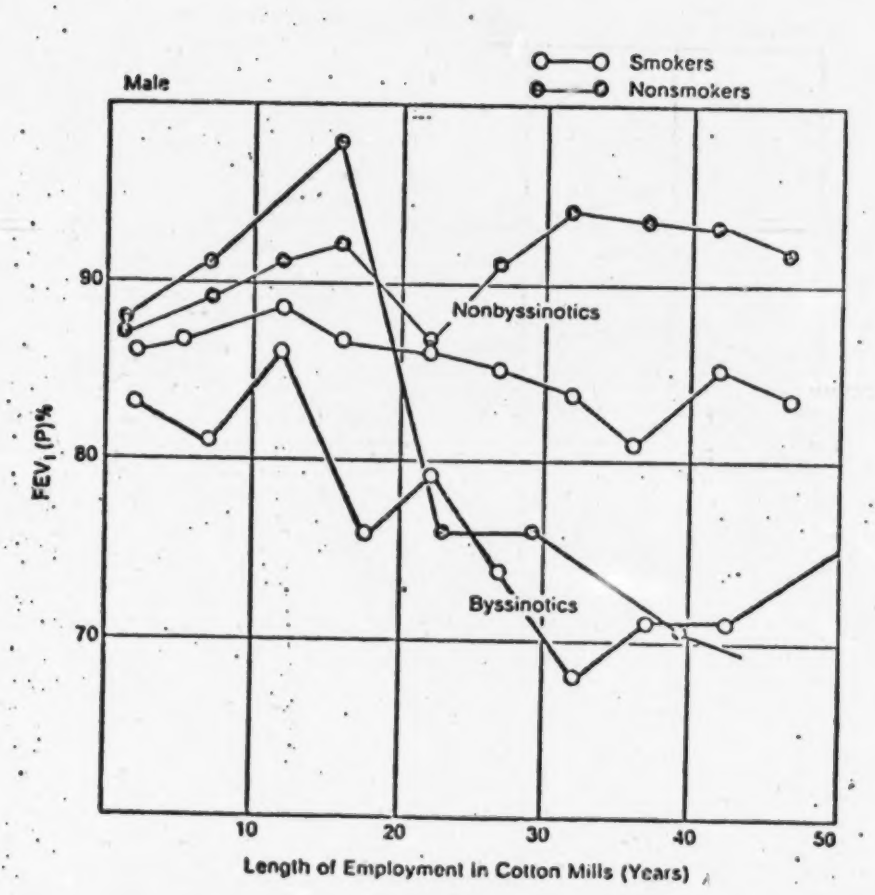


Fig. 3—Relationship between length of employment in cotton mills and average percentage of predicted FEV_1 in reference to byssinosis and smoking in men.

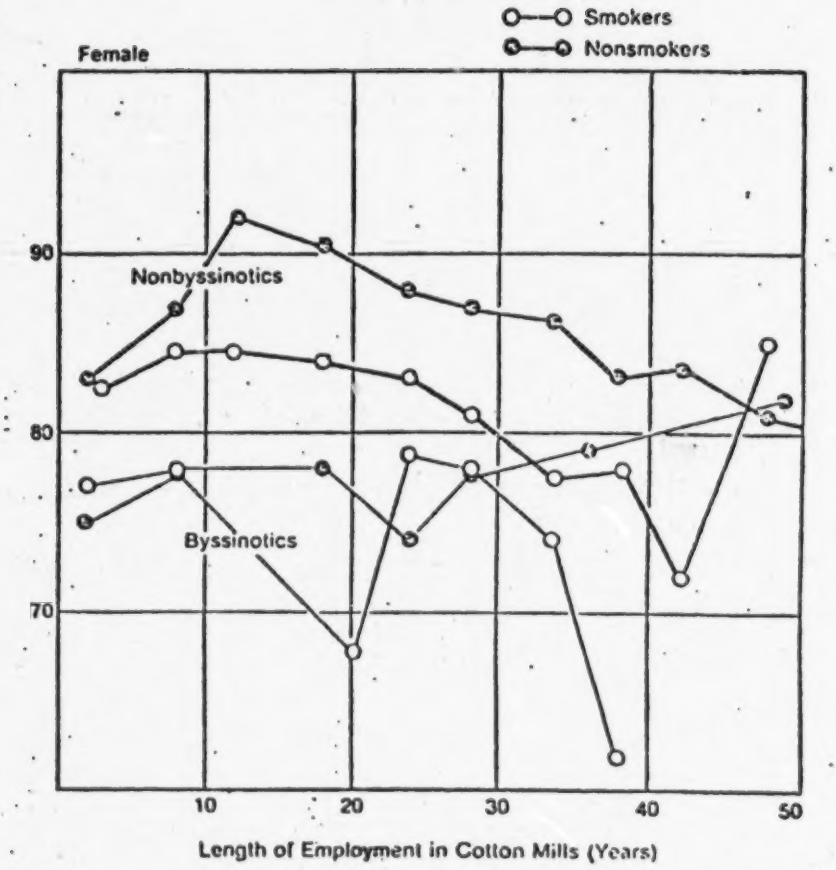


Fig. 4—Relationship between length of employment in cotton mills and average percentage of predicted FEV_1 in reference to byssinosis and smoking in women.

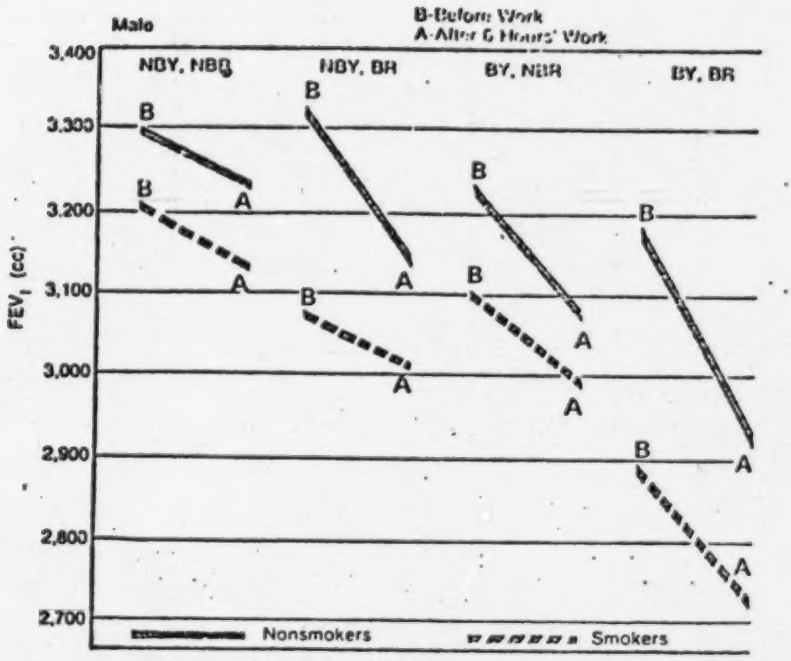


Fig. 5—Byssinosis, bronchitis, and smoking effects on FEV_1 before and after six hours' work adjusted to base age 40 years in men.

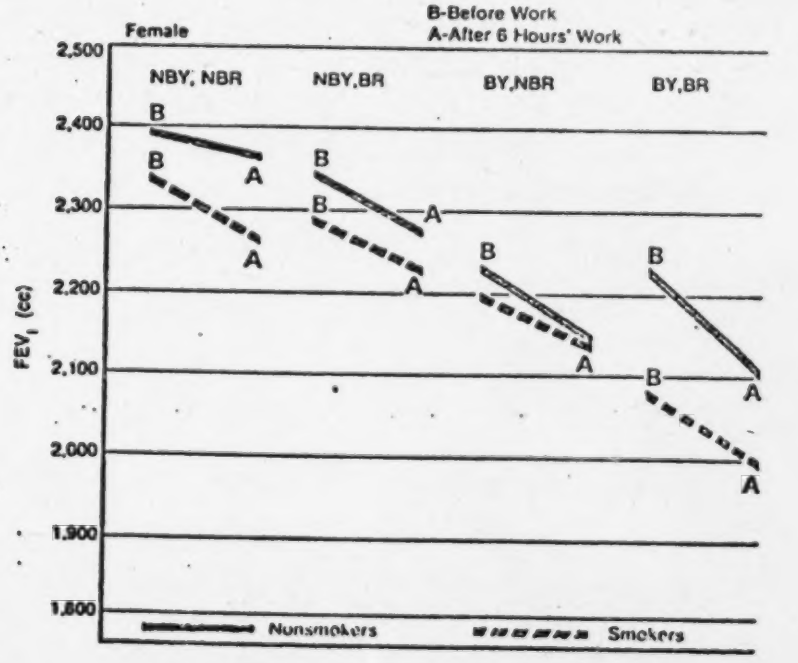


Fig. 6—Byssinosis, bronchitis, and smoking effects on FEV_1 before and after six hours' work adjusted to base age 40 years in women.

Exhibit 42B

SUPPLEMENTAL SUBMISSION TO STATEMENT AND TESTIMONY OF JACK W. WHITWORTH, M.D. MEDICAL DIRECTOR WEST POINT PEPPERELL

The data and information contained herein is made as a supplement to the oral testimony given at the hearings on the Proposed Cotton Dust Standard on April 21, 1977 (Transcript, pp. 1642-1745) and to the written statement submitted on April 1, 1977 (Exhibit No. 42) for the record as part of the American Textile Manufacturers Institute, Inc. presentation for the record. All data shown herein is taken from the initial survey referred to in the written statement submitted on April 1, 1977 (Exhibit No. 42).

In response to questions raised by representatives of various organizations during the oral testimony, shown below by sex, age group, and length of employment are the number of the 9,181 employees referred to in the written statement (Exhibit No. 42) who had the subjective symptoms of byssinosis (Grade 1/2, 1 and 2) as determined by responses to the questionnaire:

	AGE GROUPS			
	Less than 30	*30-39*	*40-49*	*50 and over*
Male	18	12	23	43
Female	5	7	9	6

Average Age—44.3 Years

	Length of Employment (Years) in Cotton Mills					
	0-8	*8-16*	*16-24*	*24-32*	*32-40*	*40-48*
Male	19	14	12	23	12	16
Female	14	2	3	5	1	2

Average Length of Employment—20.9 Years

In addition, based on our review of the individual records, the number of employees having subjective symptoms of byssinosis, Grade 1/2, as determined by the response to the questionnaire who *also* had a ten percent or greater drop in their pre-shift versus post-shift FEV_1 was 27 or 32.2% of the 87 employees determined to be Grade 1/2. In contrast, the number of employees having subjective symptoms of byssinosis, Grades 1 *and* 2, as determined by response to the questionnaire who also had a ten percent or greater drop in their pre-shift versus post-shift FEV_1 was 18 or 50.0% of the employees classified in Grade 1 and 2. In this regard, it must be noted that the percentage of employees who indicated both subjective symptoms of byssinosis, Grades 1/2, 1 and 2, as determined by their response to the questionnaire and who *also* had a ten percent or greater drop in their pre-shift versus post-shift FEV_1 was 0.5% (45 of 9,181).

Finally, as a result of the review to furnish the information set forth above, the first two sentences on page 6 of the written statement (Exhibit No. 42) submitted on April 1, 1977 should be revised to read as follows:

"Of the 9,181 individuals studied, 123 or 1.34% gave positive answers to the questions related to byssinosis as graded by the Schilling Method (Grade 1/2, Grade I, or Grade II). Of the 123 employees, 87 or 70.7% were Grade 1/2, 34 or 27.6% were Grade I and 2 or 1.6% (0.02% of all employees) were Grade II."

Exhibit 46

STATEMENT OF CHARLES F. MARTIN, M.D.
MEDICAL DIRECTOR
CONE MILLS CORPORATION
AMERICAN TEXTILE MANUFACTURERS INSTITUTE, INC.
BEFORE THE PUBLIC HEARING CONCERNING THE PROPOSED CHANGE IN THE OSHA COTTON DUST STANDARD

I am Charles F. Martin, Medical Director for Cone Mills Corporation. I have been employed with Cone since October, 1972. I would like to express some points of view as a physician who is interested in and responsible for the health of employees in a cotton textile company. I have had the opportunity of reviewing the Proposed Cotton Dust Standard, both the supporting data and the portion entitled Medical Surveillance. From my own experience, I do not feel that the prevalence rates expressed in some of the supporting documents accurately reflect what is found in the cotton textile industry.

I would like to tell you of my experiences and data which were drawn from a survey of a cotton textile manufacturing company, using both the Modified British Medical Research Council questionnaire and pulmonary function testing.

During 1973, spirograms, which are lung function tests, and questionnaires were completed by several thousand employees of Cone Mills Corporation. The data for this presentation was drawn from the records of 6,631 employees. The employees in this survey were located at 12 textile processing plants using medium and low grade cotton and at two plants that blended synthetic fiber with these various grades of cotton.

For all intents and purposes, these textile employees could be described as a "virgin" population as less than 100 of these had seen the questionnaire or performed pulmonary function tests prior to responding to the questionnaire or taking the test.

The data developed during the survey was studied in depth at a later date by Mr. James E. Higgins, M.S., biostatistician for the Department of Biostatistics, School of Public Health, Chapel Hill, N. C. and published as a paper entitled "Byssinosis and other Respiratory Diseases" in the *Journal of Occupational Medicine,* July, 1976.

The questionnaire utilized was almost the same as the one which appears in the proposed standard. The subjective responses to the questions regarding byssinosis were graded, following the classifications of Schilling, except for Grade 3, which was omitted as Grade 3 required the positive history of Grade 2 combined with objective evidence of permanent respiratory incapacity while our study primarily related to subjective symptoms of pulmonary function tests.

The questionnaires were valuable in giving us an opportunity to look at the distribution of employees by sex, race, length of employment and actual workplace.

I am supplying you with a set of tables and graphs which will make an explanation more easily followed. *Table 1* gives a distribution of our population by sex and race and shows that there were more males than females by 10% and that one-third of our population were non-whites. This population of non-whites were all blacks and this we found to be an important consideration in the grading of pulmonary function tests. Studies indicate that non-white populations have been found to have lower pulmonary function volumes.

TABLE 1
DISTRIBUTION OF EMPLOYEES BY SEX AND RACE

	No.	*%*		*No.*	*%*
Male	3,693	55.7	Female	2,938	44.3
White	2,484	67.2	White	1,867	63.5
Non-white	1,209	32.8	Non-white	1,071	36.5

Table 2 presents the length of employment by sex and race. It is important here to note that there is a high proportion of older white males who have been employed for more than 25 years. The non-whites, or black population, shows exactly the opposite trend:

TABLE 2
DISTRIBUTION OF LENGTH OF EMPLOYMENT BY SEX AND RACE

	Length of Employment (Years) in Cotton Mills							
	<1	*1-4*	*5-9*	*10-14*	*15-19*	*20-24*	*25-30*	*>30*
Male								
White	178	267	239	232	225	276	362	672
Non-white	247	333	308	78	45	41	62	65
Female								
White	141	206	253	174	137	186	283	460
Non-white	354	376	277	15	2	1	3	4

Table 3 is quite important to the discussion of contact with raw cotton trash dust as it tells us the numbers of people with complaints of chest tightness on Mondays or the first day of work after exposure which responses were elicited by the questionnaire. In brief, 3% or 199 individuals of this population of 6,631 individuals were placed in Grades 1/2 and 1. This means then that a total of 6,432 employees surveyed had no complaints which could be interpreted as subjective symptoms of byssinosis.

TABLE 3
BYSSINOSIS BY SEX AND RACE

	Byssinosis Grade				
Sex/Race	*0 (negative)*	*1/2*	*1*	*Total Byssinosis*	*%*
Male					
White	2,395	56	33	89	3.6
Non-white	1,142	57	10	67	5.5
Female					
White	1,839	16	12	28	1.5
Non-white	1,056	11	4	15	1.4
Total	6,432	140	59	199	3.0

Further analysis shows that the prevalence of the subjective symptoms of byssinosis could be related to length of employment, and that this prevalence was higher in non-white males than in white males. However, the total numbers of white males was much higher than non-white. These conclusions will become evident if you would take a moment to review *Figure 1*.

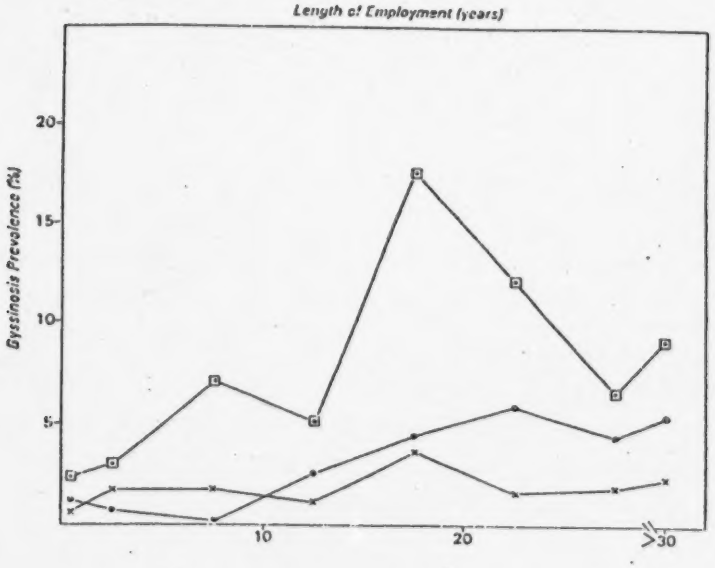
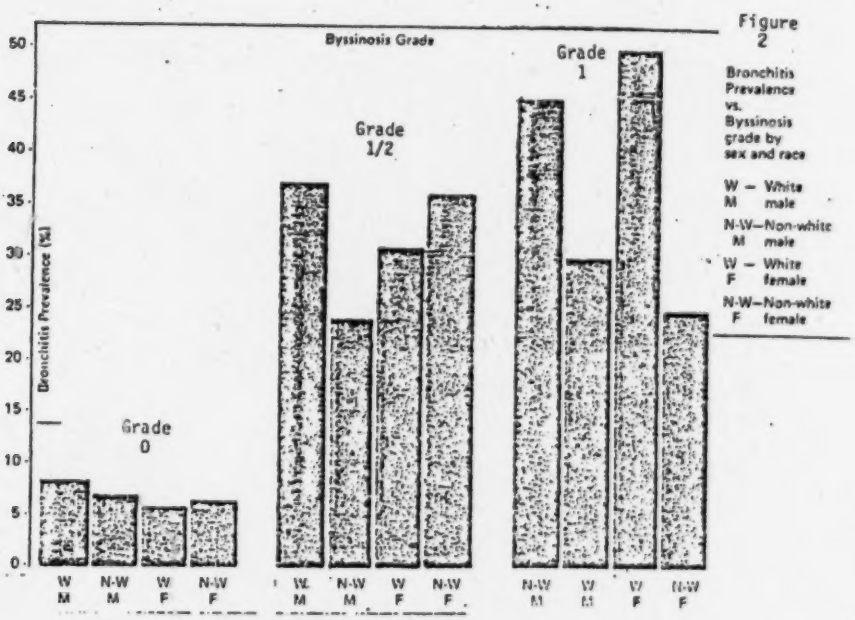


Fig 1.
Byssinosis prevalence vs. length of employment in cotton mills by sex and race
• White male
⊡ Non-white male
× Female

Now let us consider the relationship of byssinosis and bronchitis grades. We found that when byssinosis grades were compared with bronchitis grades by sex and race that byssinosis grades increased as bronchitis grades increased. Bronchitis prevalence was small (less than 1%) for those who did not give a history of subjective symptoms of byssinosis and much larger (greater than 25%) for employees with byssinosis grades one-half and one. These factors are graphically pointed out in *Figure 2* and says simply those people who complained of change in breathing on some Mondays, or every Monday also are noted to have bronchitis.

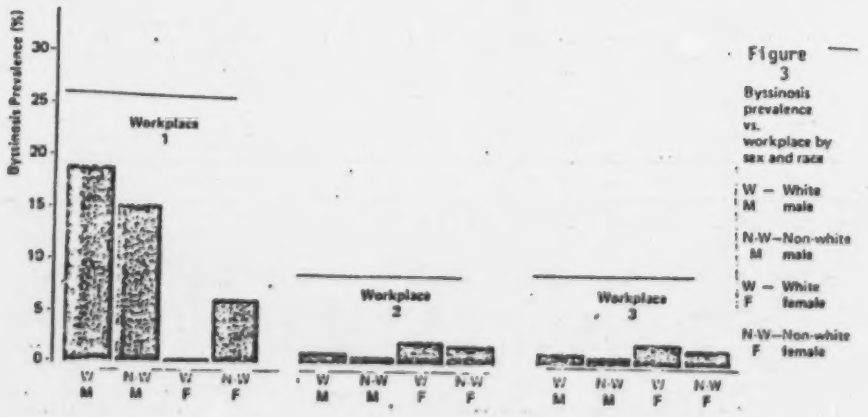


Byssinosis and Workplace

When it was established that there were some people with a history of complaints it became important to ascertain where these people spend their working lives. At the time of

this survey, accurate cotton dust measurements were not available. We simply divided the plants into three arbitrary groups representing three assumed levels for cotton dust. *Workplace 1* represented Opening, Picking and Carding; *Workplace 2*—Spinning, Winding, Twisting; *Workplace 3* —Spooling, Warping, Slashing, Weaving and other, such as Cloth Room or Maintenance. In such a division, one would expect the levels of raw cotton dust to be lower in Workplace 2 than Workplace 1 and lower in Workplace 3 than the other two. To be able to develop a true workplace history, only individuals with work histories *entirely* in each one of these three workplaces were considered. *This gave us 5,458 individuals.* In *Figure 3* you will see that, as expected, the subjective symptoms of byssinosis were more prevalent in Workplace 1. This area primarily employs men, many of whom have been on these jobs for a considerable number of years.

There were found to be *105* cases of byssinosis, grade 1/2 & 1 in Workplace 1. In terms of percentages, this represented 64% of all those complaining of subjective symptoms of byssinosis. However, only 12% of the population were employed in these first few steps of cotton processing.



Byssinosis and Smoking Habits

Now let us look at *Figure 4* in which we find a byssinosis prevalence, and a number of other factors; workplace, sex and smoking habits. The only significant association between byssinosis and smoking habits were found for those males in Workplace 1. The Workplace 1 males did not possess smoking habits which differ greatly from the general male population except that the rate of heavy smoking was lower. Prevalence rates for byssinosis in this workplace location indicate possible interaction between the workplace and smoking habits.

It is worth the comment that cigarette smoking habits and bronchitis seem to closely parallel complaints of byssinosis for those males who are employed in Workplace 1. The clinical observation that byssinosis complaints occur primarily in cigarette smokers is borne out by the finding that only 20% of those complaining of byssinosis were non-smokers.

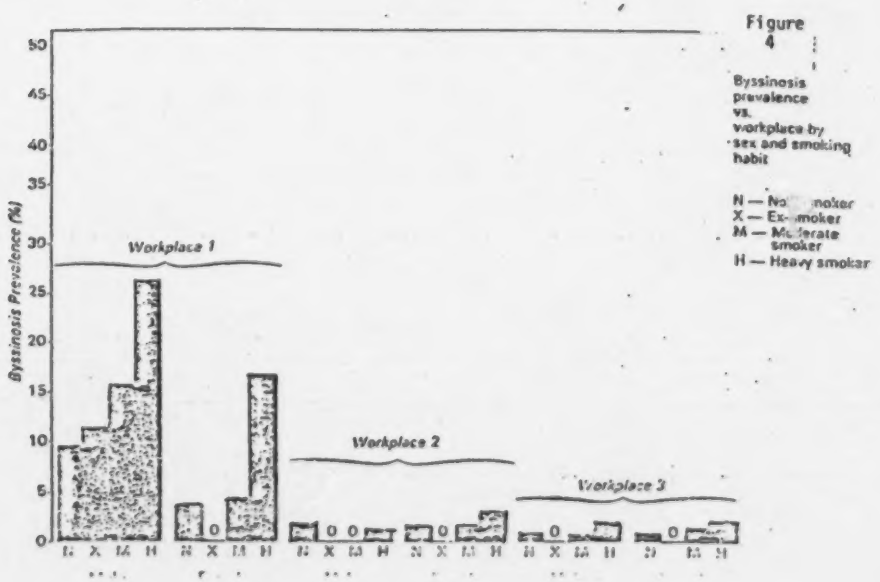


Figure 4

Byssinosis prevalence vs. workplace by sex and smoking habit

Following completion of the questionnaires, spirograms were performed on each individual. Using the answers on the questionnaire and the result of spirograms, a decision was made to reinterview and retest those employees who were classified as having significant complaints and/or poor pulmonary function tests which did not meet pre-determined criteria. In using this type of separation procedure, approximately 10% of our study population were re-examined. Those who were found to have any type of respiratory disease received further clinical evaluation. For, it is paramount to recognize in a medical survey any disease which is found is important. Thus, although we were primarily interested in ascertaining the prevalence of byssinosis, other respiratory diseases which were uncovered were certainly of equal importance.

Since 1973 the spirogram program has been continuing on an annual basis with the selection of certain employees for further clinical evaluations. The British Research Council Questionnaire has been administered as an initial questionnaire for new people coming into the program and has not been repeated except for those for whom additional evaluation is indicated.

Final conclusions which were drawn from this study were that a majority of the complaints of byssinosis were found among the relatively small subset of employees located in the high dust work areas of Opening, Picking, and Carding. Byssinosis was significantly associated with bronchitis. Smoking was significantly associated with byssinosis for employees in Opening, Picking and Carding. While 3% of the population had subjective symptoms (history) of byssinosis, only 0.8% indicated both subjective symptoms and objective signs (a 10% or greater drop during the workday of forced expiratory volume for one second [FEV_1]).

CONCLUSIONS

With our four-year experience and conclusions as background, I would like to comment on the medical surveillance program as it is proposed in the cotton dust standard.

SPECIFIC COMMENTS ON MEDICAL SURVEILLANCE PROGRAM

THE STANDARD QUESTIONNAIRE

It is a valid tool when used for evaluating an untested population to establish an initial history, but it is lacking in flexibility, and in the future I am sure will be a victim of coaching. There are additional questionnaires which would aid in establishing history of change in respiratory function which should be acceptable from a clinical point of view.

PERIODIC EXAMINATION

This portion of the regulations would strain our already overtaxed resources. I do not feel that there is any rationale in providing an examination every six months for those with an FEV_1 greater than 80% of predicted with an FEV_1 decrement of 5% or for those employees whose FEV_1 is, for example, 70-79% if there is no further FEV_1 decrement.

A spirogram is effort dependent and requires the cooperation of the individual to produce the maximum effort. We have found it next to impossible to maintain a 5% range, testing an individual from one part of the day to another. Actually, this degree of tolerance or low volume change would be difficult to maintain in a hospital laboratory setting using trained people for the test subjects.

Objections are raised to (3) (a) and (b) as currently presented. These subparagraphs would dictate time and

effort being spent every six months in testing a large portion of the population, most of whom will be repeatedly found not to have pulmonary disease. A medical decision should be made concerning questionable spirograms as our attention must be directed toward those workers who would require intervention.

The basic phsiologic concept is that byssinosis is a reversible bronchio-constricting airway condition. The susceptibility to the condition is on an individual basis, and many years of contact to raw cotton trash dust is required before any chronic irreversible changes can be noted.

It would seem reasonable then to construct screening procedures for cotton textile manufacturing employees that have been developed for preventive medical and public health programs. Such a screening program would include the standard questionnaire initially, followed by pulmonary function tests. The analysis of this data would be used to identify those with respiratory complaints and/or poor spirograms. Re-question and re-test specific individuals to validate the questionnaires and test findings and make specific recommendations for future action would be required.

The bulk of the population then, whose examinations did not indicate immediate concern would be followed by an annual test schedule which would note any individual changes.

Thus the entire population would be under regular observation but the time would be available to care for those with specific needs.

PHYSICIAN'S WRITTEN OPINION

If the physician were supplied with a questionnaire and spirogram of the employee and asked to give an "opinion

as to whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of health from exposure to cotton dust" as proposed, the physician would find it difficult to comply. In many instances I would foresee that the physician would require another physical examination and laboratory evaluation before attempting to give such an opinion. Again it would lead to a quandary because the physician could not always know what the term *"Material Impairment"* might imply. Neither is there a specific test for "exposure to cotton dust" as the chemical compounds which may have health effects have not been identified.

Objections are raised to (h) (5) (ii) in that there seems to be a conflict with (h) (5) (i) and (a).

The heading (h) (5) (ii) would limit the communication between doctor and patient and would restrict health counseling *only* to the cotton dust exposure, eliminating the possibility of employment in a second job with another industry. Also, counseling on the best known pulmonary irritant, cigarette smoking, would apparently be eliminated.

In conclusion, medical surveillance of our cotton textile employees is not an insolvable problem if factual information is taken into consideration and regulations are written so that we can comply with them from a professional as well as industrial management standpoint.

Exhibit 2

EXCERPT FROM FEDERAL REGISTER

TUESDAY, DECEMBER 28, 1976

PART III

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

COTTON DUST

Proposed Standards for Exposure and Notice of Hearing

* * *

Byssinosis is a specific respiratory disease, the symptoms of which are attributable to the action of cotton dust on the respiratory passages. The effects of byssinosis can be temporary or permanent, depending upon the exposure and the individual, and can lead in time to chronic obstructive lung disease, primarily chronic bronchitis. (*20, 21*) Initially, the individual notices a tightness in the chest occurring on the first day of the work week. The tightness may be accompanied by a measurable decrease in breathing capacity as measured by pulmonary function tests. Usually, the condition is mild and temporary at first, tending in time to progress to the stage where it bothers the workers on other days of the work week. This progression, which is characterized by constriction of the bronchial tubes of the lung, leads to a permanent narrowing of these airways. The individual develops a chronic cough with a production of phlegm and increasing shortness of breath. At this stage, the condition is readily detectable by pulmonary function measurements. Total disability and even death may follow. The description of these detailed symptoms appeared as early as 1908 in the work of Collis. *(10)*

Exhibit 6, No. 76

July 26, 1976

Contract No. J-9-F-6-0035

RTI Project No. 44U-1204-1

COTTON DUST

PART 1: CHAPTERS I-VI

EXCERPTS FROM

TECHNOLOGICAL FEASIBILITY ASSESSMENT

AND

FINAL INFLATIONARY IMPACT STATEMENT

Prepared for:
Occupational Safety and Health Administration
U.S. Department of Labor

RESEARCH TRIANGLE INSTITUTE
Post Office Box 12194
Research Triangle Park, North Carolina 27709

[I-15]

TABLE I-6

TOTAL INSTALLED AND ANNUALIZED COMPLIANCE COSTS: ALL SECTORS
(Costs in Millions of Dollars)

Industry Sector	*Exposure Limit* (mg/m^3)	*Installed Cost*	*Annualized Capital Charge*	*Direct Operating Cost*	*Energy Cost*	*Total Annualized Cost*
Yarn Production	0.5	211.8	33.8	6.9	20.6	61.5
	0.2	984.4	158.3	15.6	67.9	241.6
	0.1	2,802.7	450.6	23.3	147.0	620.6
Cotton Ginning	0.5	16.9	2.7	4.9	1.8	9.4
	0.2	292.2	47.0	13.2	30.3	90.4
	0.1	343.6	55.2	14.7	35.4	105.3
Cotton Weaving	0.5	9.1	1.5	1.7	0.6	3.7
	0.2	1,387.9	223.1	40.7	86.3	350.1
	0.1	3,939.1	633.2	112.6	245.1	990.9
Waste Processing	0.5	17.3	2.8	2.6	2.5	7.9
	0.2	32.0	5.2	2.9	4.7	12.8
	0.1	56.1	9.0	3.4	8.2	20.6
Total	0.5	255.1	40.8	16.1	25.5	82.5
	0.2	2,696.5	433.6	72.4	189.2	694.9
	0.1	7,141.5	1,148.0	154.0	435.7	1,737.4

TABLE V-11

TOTAL INDUSTRY COSTS FOR ENGINEERING CONTROLS (Weaving)

	0.5 mg/m³				0.2 mg/m³				0.1 mg/m³			
Equipment Type	*Capital* ($10⁶)	*Maintenance and Operations* ($10³/yr)	*Energy* (10⁶ Kwh/yr)	*Labor* (man-hrs/yr)	*Capital* ($10⁶)	*Maintenance and Operations* ($10³/yr)	*Energy* (10⁶ Kwh/yr)	*Labor* (man-hrs/yr)	*Capital* ($10⁶)	*Maintenance and Operations* ($10³/yr)	*Energy* (10⁶ Kwh/yr)	*Labor* (man-hrs/yr)
Winders	1.620	11.267	8.350	1,609	6.265	54.599	31.010	3,900	17,794	155.07	88.32	11,075
Spoolers	6.088	45.577	31.383	6,511	35.306	351.60	175.147	50,510	100.270	999.53	497.42	142,645
Twisters	—	—	—	—	47.464	433.36	237.320	61,908	134.798	1,231.60	673.99	175,819
Warpers	—	—	—	—	38.702	468.50	269.291	66,928	109.913	1,330.53	764.78	190,076
Looms	—	—	—	—	1,258.75	37,762,56	5,244.80	539,465	3,574.86	107,245.67	14,895.23	1,532,081

[VI-8—VI-9] b. *Economic Impact Analysis Procedure*

The economic impact analysis that follows in Section 2 assesses and evaluates the likely economic impact upon six industries (SIC Codes 2211, 2221, 2281, 2257, 2284, and 2296) and upon the U.S. economy of the three OSHA exposure limits for cotton dust of 0.5, 0.2 and 0.1 mg/m^3. In Section 3, similar economic impact analyses are reported for the other cotton processing industries. Specifically, this chapter includes the analysis of impacts on:

1) Additional employment requirements.

2) Energy consumption.

3) Increases in production costs and consequent price increases by affected industries.

4) Capital requirements and capital financing problems.

5) Competition effects on profit and market structure.

6) Inflationary impact on consumer and U.S. economy.

7) Employment impact due to the contraction of output demand.

Major procedures adopted in the impact analysis are as follows: first, in order to determine the levels of average price increases which are likely to occur after the imposition of the exposure limits, it has been necessary to estimate the average rate of return on investment at the industry level, both before and after implementation of the required controls. It is then assumed that the average output price levels of each of the six industries will be increased after compliance to the level required to maintain the pre-compliance rate of return on investment.

TABLE VI-9

FINANCIAL IMPACT OF OSHA COTTON DUST EXPOSURE LIMITS
($/Pound of Cotton Yarn Produced)

SIC	Exposure Limit mg/m³	Total Assets	Average Price of Cotton Yarn ($/lb.)	Total Cost	Profit After Tax	Rate of Return to Investment (ROI)	Price Increase Required to Maintain Pre-Control ROI ($/lb.)	Percent of Increase
2211	0.5	0.775	1.176	1.138	.0207	.0267	.020	1.7
	0.2	0.975	1.176	1.185	−.0046	−.0047	.082	7.0
	0.1	1.445	1.176	1.283	−.0580	−.0401	.216	18.3
2221	0.5	0.775	1.176	1.138	.0207	.0267	.020	1.7
	0.2	0.975	1.176	1.185	−.0046	−.0047	.082	7.0
	0.1	1.445	1.176	1.283	−.0580	−.0267	.216	18.3
2281	0.5	0.775	1.176	1.138	.0207	−.0267	.020	1.7
	0.2	0.975	1.176	1.185	−.0046	−.0047	.082	7.0
	0.1	1.445	1.176	1.283	−.0580	−.0401	.216	18.3
2257	0.5	0.972	1.483	1.434	.0267	.0274	.024	1.6
	0.2	1.242	1.483	1.495	−.0068	−.0054	.106	7.2
	0.1	1.908	1.483	1.626	−.0778	−.0408	.287	19.4
2284	0.5	0.972	1.483	1.434	.0267	.0274	.024	1.6
	0.2	1.242	1.483	1.495	−.0068	−.0054	.106	7.2
	0.1	1.908	1.483	1.626	−.0778	−.0408	.287	19.4
2296	0.5	0.679	1.023	0.991	.0173	.0255	.019	1.9
	0.2	0.863	1.023	1.035	−.0064	−.0074	.077	7.5
	0.1	1.281	1.023	1.123	−.0545	−.0425	.197	19.2

Sources: Calculations are based on data in Tables VI-3 and VI-7a.

[VI-35—VI-37] As mentioned previously, this is why the rate of return approach is preferred to the simple cost pass-through approach which assumes the price increases per dollar of sales equals the total annualized cost per dollar of sales. Moreover, it is important to note that price increases required to maintain pre-control ROI for the 0.1 mg/m^3 exposure limit are 200—300 percent of those required at the 0.2 mg/m^3 exposure limit and 900—1000 percent of those required by the 0.5 mg/m^3 exposure limit. Additionally, in the absence of price increases, profit-after-taxes and ROI would be very small or negative in some cases.

Table VI-9 represents similar computations as above, but they are estimated per pound of cotton yarn produced. The average prices of cotton yarn produced in each sector are estimated on the basis of the observation that SIC Codes 2257 and 2284 typically produce and consume a higher quality of yarn than the other sectors and SIC Code 2296 consumes a lower quality of yarn. SIC Codes 2211 and 2221 are assumed to produce and consume a combination of several qualities of yarn, similar to that produced by SIC Code 2281.

Table VI-9 indicates, for example, that for SIC Codes 2211, 2221, and 2281, 2.0, 8.2 and 21.6 cents are required per pound of cotton yarn produced to maintain the pre-control return on investment after exposure limits of 0.5, 0.2, and 0.1 mg/m^3 are imposed. SIC Codes 2257 and 2284 require 2.4, 10.6 and 28.7 cents per pound of yarn to maintain pre-control rates of return and to satisfy the three exposure limits. SIC Code 2296 requires 1.9, 7.7 and 19.7 cents. In this computation, the production losses in yarn spinning were ignored. It is worth noting that all the sectors had negative "profits after taxes" for 0.2 and 0.1 mg/m^3 exposure limits, if no price increases are assumed.

[VI-39] * * *

As is well known (from Marshall) the derived input demand elasticities depend upon four different factors: elasticity of input substitution; supply elasticity of inputs; share of that input cost in total production cost; and output demand elasticities for the products which are produced using these inputs. The detailed data on these factors are not available and to estimate the accurate derived demand elasticity is beyond the scope of this study. Therefore, it was decided to adopt an extreme assumption of zero price demand elasticity in computing the post-control price increases. However, it is of great interest to investigate how much bias the estimated results will have due to the assumption of zero price elasticity of demand when the real elasticity is actually non-zero. More accurately, equation (2) can be rewritten as:

$$\text{PROI} = \left[\frac{(\text{P} + \text{PINC}) \times (1 - \text{n} \cdot \text{PINC}) \times \text{PRVL}}{(\text{PRAS} + \text{TIC}) \times \text{PRVL}} - \frac{[\text{PRTC} \times \cdot 90 \times (1 - \text{n} \cdot \text{PINC}) \times \text{PRVL} + \text{PRTC} \times \cdot 1 \times \text{PRVL} + \text{TAC} \times \text{PRVL}]}{(\text{PRAS} + \text{TIC}) \times \text{PRVL}}\right] \times (1 - \text{Tax Rate}) \quad (4)$$

where n is the price elasticity of demand for the output of the sector, and PRVL is the pre-control total value of industry shipments.

Exhibit 6, No. 76

AMERICAN TEXTILE MFRS. INSTITUTE, INC.

Wachovia Center, 400 S. Tryon St.
Charlotte, N. C. 28285

July 26, 1976

Contract No. J-9-F-6-0035
RTI Project No. 44U-1204-1

COTTON DUST

PART II: APPENDIXES

EXCERPTS FROM TECHNOLOGICAL FEASIBILITY ASSESSMENT AND FINAL INFLATIONARY IMPACT STATEMENT

Prepared for:
Occupational Safety and Health Administration
U.S. Department of Labor

Research Triangle Institute
Post Office Box 12194
Research Triangle Park, North Carolina 27709

[C-35] 8. *Fiber Consumption*

Cotton's share of the total domestic fiber market has declined consistently from the 1947-52 average of about 70 percent to 29.5 percent of the market in 1974. Cotton's market share remained above 50 percent until 1967, as

shown in Table C-20, after which it dropped rapidly. The decline in mill consumption of cotton in the U.S. was due primarily to the development of synthetic fibers and yarns, and in particular the development of textured yarns. Fabrics made from some synthetic fibers have historically possessed attractive properties such as superior wear and easy-care properties, but many of these fabrics were smooth and slippery to the touch and felt clammy when worn next to the skin. They often did not possess the warmth and comfort of fabrics made from cotton and other natural fibers. Synthetic yarns spun from staple afforded some of the advantages of cotton, and helped alleviate some of the disadvantages of filament yarns, but not all of them. Textured yarns followed.

Fabrics made from textured yarns have greater bulk, drier hand, high covering power, increased comfort, increased moisture absorption, improved thermal insulation, and more subdued luster when compared to fabrics made from continuous filament yarns. When compared to fabrics made from spun staple of equivalent denier*, fabrics made from textured yarns have (typically) equal or lower bulk density, a drier and crisper handle, a significantly improved freedom from pilling, and much greater uniformity. These properties substantially improve the quality of the fabric and add to consumer satisfaction. In addition, blends of cotton and synthetics, primarily nylon and polyester, have cut substantially into the market for cotton. In 1974, consumption of man-made fiber at the mill level constituted almost 70 percent of the market.

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* A unit of fineness for silk, rayon or nylon yarn equal to the fineness of yarn weighing one gram for each 9,000 meters.

TABLE C-20

TOTAL FIBER CONSUMPTION BY U.S. TEXTILE MILLS

	Total Mill Fiber Consumption	*Cotton*		*Manmade Fiber*		*Wool*	
Year	10^6 lbs.	10^6 lbs.	Share (%)	10^6 lbs.	Share (%)	10^6 lbs.	Share (%)
1947	6433.7	4685.6	72.5	1057.9	16.4	698.2	10.9
1948	6409.2	4463.5	69.6	1239.7	19.3	693.1	10.8
1949	5451.5	3839.1	70.4	1101.9	20.2	500.4	9.2
1950	6857.3	4882.7	68.3	1518.4	22.1	634.8	9.3
1951	6849.7	4868.6	71.1	1478.6	21.6	484.1	7.1
1952	6446.8	4470.9	69.4	1490.2	23.1	466.4	7.2
1953	6489.2	4456.1	68.7	1523.7	23.5	493.9	7.6
1954	6035.2	4127.3	68.4	1508.3	25.0	380.8	6.4
1955	6717.7	4382.4	65.2	1902.5	28.3	413.8	6.2
1956	6551.4	4362.6	66.6	1727.4	26.4	440.8	6.7
1957	6237.3	4060.4	65.1	1792.6	28.7	368.7	5.9
1958	5971.5	3866.9	64.8	1764.2	29.5	331.1	5.5
1959	6846.4	4377.8	63.9	2064.8	30.2	435.3	6.4
1960	6491.6	4232.8	65.2	1878.0	28.9	411.0	6.3
1961	6570.7	4122.3	62.7	2064.4	31.4	412.1	6.3
1962	7654.6	4229.8	60.0	2425.1	34.4	429.1	6.1
1963	7226.9	4080.6	56.5	2775.0	38.4	411.7	5.9
1964	7763.3	4286.9	55.2	3162.2	40.7	356.7	4.6
1965	8478.7	4522.2	53.3	3614.1	42.6	387.0	4.6
1966	8990.8	4676.8	52.0	3990.1	44.4	370.2	4.1
1967	8980.8	4470.2	49.8	4245.3	47.3	312.5	3.5
1968	9781.7	4188.0	42.8	5305.5	54.2	329.7	3.4
1969	9798.0	3972.5	40.5	5552.2	56.7	312.8	3.2
1970	9557.2	3853.8	40.3	5501.3	57.6	240.3	2.5
1971	10677.1	3985.6	37.3	6539.3	61.2	191.5	1.8
1972	11862.0	3864.0	33.1	7602.1	65.2	218.6	1.9
1973	12474.1	3657.6	29.3	8665.3	69.5	151.3	1.2
1974	11194.9	3309.0	29.6	7792.4	69.6	93.5	0.8

Source: USDA, *U.S. Textile Fiber Demand: Price Elasticities in Major End-Use Markets*, 1974, and USDA, *Cotton and Wool Situation*, 1976

TABLE C-25

U.S. IMPORTS OF TEXTILE MANUFACTURES IN DOLLARS AND EQUIVALENT SQUARE YARDS, BY CALENDAR YEAR, 1960-1975

	Cotton[a]		*Manmade Fiber*[b]		*Wool*[c]		*Total*[c]	
Year	10^6	10^6 Equivalent Sq. Yds.	10^6	10^6 Equivalent Sq. Yds.	10^6	10^6 Equivalent Sq. Yds.	10^6	10^6 Equivalent Sq. Yds.
1960	269	1,054	61	149	216	111	546	1,314
1961	199	720	60	151	200	85	459	956
1962	307	1,165	78	213	272	156	657	1,534
1963	299	1,101	90	221	297	161	686	1,483
1964	310	1,058	129	328	289	138	728	1,524
1965	369	1,313	193	566	357	212	919	2,090
1966	463	1,824	258	798	354	204	1,075	2,826
1967	417	1,485	312	934	327	167	1,056	2,586
1968	477	1,648	499	1,453	410	210	1,386	3,311
1969	527	1,652	695	1,783	410	192	1,632	3,626
1970	536	1,537	1,053	2,760	358	170	1,947	4,466
1971	590	1,611	1,553	4,229	292	117	2,435	5,957
1972	801	1,924	1,730	4,275	314	117	2,845	6,317
1973	887	1,592	1,848	3,434	368	99	3,103	5,125
1974	1,034	1,463	1,777	2,862	356	86	3,167	4,410
1975	1,000	1,281	1,773	2,467	340	78	3,114	3,826

Source: U.S. Department of Commerce and ATMI *Textile Hi-Lights*, March 1974 and March 1976, pp. 26 & 27.

[a] U.S. Department of Commerce conversion factors used by ATMI to convert units of yarns, apparel, make-up goods and miscellaneous items to sq. yd. equivalent.

[b] Equivalent square yards for 1960 and 1961 were converted by ATMI; for 1962-1975, U.S. Department of Commerce conversion factors were used by ATMI to convert sq. yd. equivalent.

[c] Includes wool floor coverings from 1960-1973.

TABLE C-27

U.S. EXPORTS OF COTTON TEXTILE MANUFACTURES, BY CALENDAR YEARS, 1963-1975
(Millions of Equivalent Square Yards [a])

Year	Yarns	Broadwoven Fabric	Apparel	Make-Up Goods[b]	Miscel-laneous
1963	35.1	368.2	64.2	45.9	99.4
1964	42.9	393.1	76.0	59.1	80.8
1965	38.0	308.1	73.2	57.7	100.6
1966	36.8	336.6	83.1	59.7	97.2
1967	32.4	288.0	94.1	62.7	98.4
1968	26.9	273.1	111.1	61.3	105.8
1969	160.7	299.7	143.3	55.1	119.0
1970	70.2	266.6	119.9	54.0	118.8
1971	75.2	301.0	120.2	59.8	138.5
1972	86.5	378.7	137.6	67.3	202.8
1973	81.4	443.2	120.9	98.0	246.8
1974	94.4	517.0	161.6	131.7	310.3
1975	65.2	454.6	143.2	132.9	250.5

Source: U.S. Department of Commerce and ATMI, *Textile Hi-Lights*, March, 1974 and 1976, p. 28.

[a] U.S. Department of Commerce conversion factors used to convert units to square yards equivalents, except for broadwoven fabrics.

[b] Make-up goods consist of sheets, pillow cases, dish towels, other towels, table cloths, bedspreads, quilts, etc.

By 1970 over $1.94 billion of foreign textile manufactures reached U.S. markets. Of this import figure, about $1.05 billion was attributable to manmade fiber products, about $536 million was cotton products, and $358 million was wool products. In 1971 imports of manmade fiber products into the U.S. increased 50 percent over the 1970 figure to over $1.55 billion, as compared to $590 million for cotton products, $292 million for wool products, $2.435 billion for the total imports of textile manufactures, and $2.9 billion for total textile imports.

Textile manufactures, as discussed here, are essentially manufactured textile products and are a good measure of the foreign trade activity most central to the industries of interest in this study, namely SIC Codes 2211, 2221, and 2281. In this sense, textile manufactures consist of yarns, broadwoven fabrics, woven and knitted apparel, make-up goods (pillow cases, dish towels, other towels, table cloths, sheets, bedspreads, quilts, etc.), and miscellaneous items not classified elsewhere (woven elastic, fishing nets, etc.) See Tables C-25, C-26 and C-27 for additional data.

Given these data, it is clear that the LTA, with its singular emphasis upon cotton and cotton blends, was inadequate to control the growth rate of textile and apparel imports into the U.S. As a consequence, in 1971 President Nixon's Administration led the negotiation of new bilateral trade agreements with five countries (Japan, Taiwan, Hong Kong, South Korea, and Malaysia) covering exports to the U.S. of wool and manmade fiber textiles and apparel, in addition to cotton textile and apparel products covered under the LTA. These agreements imposed trade limitations upon some eighteen classifications of textile and apparel products from Japan, covering some 50 percent of Japanese exports of wool and manmade fiber products to the U.S., and ten categories, covering about 80 percent of their U.S.

exports, for the other countries. These became effective on October 1, 1971. Under the terms of these agreements, Japan agreed to limit the rate of growth of exports of these classifications of textile and apparel products to the U.S. to 5 percent per year for man-made and one percent for woolen products for three years, while the other agreements were for five years and limited the rate of growth of exports of these products to the U.S. to approximately 7.5 percent per year. In 1973, additional agreements were negotiated with Singapore and Macao.

These agreements were neither a comprehensive nor a long-run solution, and a more general international framework was sought. In the Multi-lateral Trade Negotiations in Geneva, which dealt with all international trade activities (including textiles and apparel), and in other negotiations, GATT developed the Arrangement Regarding International Trade in Textiles or the Multi-Fiber Arrangement Regarding International Trade in Textiles (MFA), which was accepted by the U.S. and became effective on January 1, 1974. Under the MFA, the U.S. has negotiated bilateral agreements with some sixteen countries covering cotton, wool and manmade fiber products. The terms of each of these agreements differ somewhat, but the rate of growth of exports from these countries to the U.S. typically is in the six to seven percent range for included products.

Excerpts of Exhibit 60

[p. 1]

STATEMENT OF HOVAN HOCUTT SENIOR VICE PRESIDENT, ENGINEERING PNEUMAFIL CORPORATION BEFORE THE PUBLIC HEARING CONCERNING THE PROPOSED CHANGES IN THE OSHA COTTON DUST STANDARD

My name is Hovan Hocutt. I have a Bachelor of Science degree in Aeronautical Engineering from North Carolina State University and I am a licensed Professional Engineer. I have 13½ years experience as factory engineer and officer of a woven asbestos brake lining factory where one of my responsibilities was the engineering control of asbestos dust. I am now Senior Vice President-Engineering of the Pneumafil Corporation, Charlotte, N. C. where I have been since 1950. Pneumafil Corporation was formed in 1946 to design and manufacture systems for the control of lint and dust in the textile yarn manufacturing industry. This has always been its primary business. We are in regular contact with leading manufacturers of cotton dust control systems in England, Germany, Switzerland, Hong Kong, Japan and other foreign countries.

In June of 1972, Pneumafil Engineers began work on NIOSH Contract HSM 99-72-44 to determine what engineering controls would be necessary to achieve a dust level of 0.5 mg/M^3 as measured by the vertical elutriator (VE) in the processing areas of opening, picking, carding, drawing and combing. Some investigation of dust capture devices and air quantities required to achieve 0.2 or 0.1 mg/M^3 VE was also included.

[18-19] * * *

6. Obviously, based on this factual data it is economically and technically unfeasible to achieve a raw cotton dust level of 0.2 mg/M³ VE $\overline{X}$ in processes past roving. Also, the capacity of the dust control industry is reflected by the total sales of $12 million which represents the largest sales year ever. At best, this capacity could increase approximately two to three times with the new demand. This means that if sales were to reach $30 million, it would take at least eleven years to supply the equipment necessary to reach a level of 0.2 mg/M³ VE $\overline{X}$ in opening-carding only.

COST/DOLLARS
COTTON DUST CONTROL SYSTEMS

Textile Process	0.5 Mg/M³ VE $\overline{X}$ Equip. Cost	Maintenance Cost/Year	Energy Cost/Year	0.2 Mg/M³ VE $\overline{X}$ Equip. Cost	Maintenance Cost/Year	Energy Cost/Year
Opening	6,256,388	133,312	589,963	25,818,973	262,852	1,190,900
Picking	21,914,519	397,241	2,254,650	42,762,527	542,545	3,346,151
Carding	29,337,703	672,046	3,751,459	121,868,495	1,527,603	10,541,040
Sub-Total	57,508,610	1,202,599	6,596,072	190,449,995	2,333,000	15,578,091
Drawing	13,697,778	132,622	1,368,075	44,212,483	411,112	5,000,936
Combing	—	—	—	6,874,565	67,848	813,529
Roving	5,412,737	52,754	528,683	37,169,720	429,793	4,088,148
Opening—Roving Sub-Total	76,619,125	1,389,781	8,492,830	278,708,763	3,241,753	25,480,704
				0.5 Mg/M³ VE X		
Spinning	13,517,498	379,803	1,582,088	13,517,498	379,803	1,582,088
Twisting	—	—	—	—	—	—
Winding	14,383,500	95,900	1,389,080	14,383,500	95,900	1,389,080
Spooling	2,965,900	21,188	327,485	2,965,900	21,188	327,485
Warping	—	—	—	—	—	—
Spinning—Warping Sub-Total	30,866,898	496,891	3,298,653	30,866,898	496,891	3,298,653
	1.0 Mg/M³ VE $\overline{X}$			1.0 Mg/M³ VE $\overline{X}$		
Slashing	—	—	—	—	—	—
Weaving	41,560,769	204,944	6,151,937	41,560,769	204,944	6,151,937
Total	149,046,792	2,091,616	17,943,420	351,134,430	3,943,588	34,931,294

These figures represent the estimated economic impact on the industry as of 2/11/77. The totals *do not include the following credits* allowed for dust control systems purchased by the industry before 2/11/77:

Towards compliance with 0.5 mg/m³ VE $\overline{X}$ standard-opening = $12,151,541, picking = $5,685,038, carding = $32,333,474, drawing = $210,441, Total = $50,380,494.

Towards compliance with 0.2 mg/m³ VE $\overline{X}$ standard-opening = $10,693,356, picking = $5,002,834, carding = $28,453,457, drawing = $185,188, Total = $44,334,835.

Excerpts from Exhibit 62

STATEMENT OF ARTHUR THOMAS
SENIOR VICE PRESIDENT
THE BAHNSON COMPANY
SUBSIDIARY OF ENVIROTECH CORPORATION
WINSTON-SALEM, NORTH CAROLINA
BEFORE THE PUBLIC HEARING CONCERNING
THE PROPOSED CHANGE IN THE
OSHA COTTON DUST STANDARD

* * *

ATMI ECONOMIC IMPACT STUDY

Estimated Temperature and Relative Humidity Compliance Cost (Dollars)

Dust Level mg/m³	*Textile Process*	*Equipment Cost*	*Annual Maintenance Cost*	*Annual Energy Cost*	*Operating Brake Horsepower*
.5 VE	Opening	9,311,460	163,103	336,438	4,172
.5	Picking	22,595,910	620,904	1,228,975	15,373
.5	Carding	28,515,838	635,404	1,853,548	23,673
.5	Sub-total	60,423,208	1,419,411	3,418,961	43,218
.5	Drawing	12,829,474	272,404	737,361	9,220
.5	Combing	—	—	—	—
.5	Roving	5,375,854	104,521	183,090	3,554
.5	Opening-Roving Sub-total	78,628,536	1,796,336	4,339,412	55,992
.5	Spinning	4,286,350	143,698	209,323	4,278
.5	Twisting	—	—	—	—
.5	Winding	5,283,507	164,371	210,252	4,297
.5	Spooling	1,210,988	33,890	43,303	885
.5	Warping	—	—	—	—
.5	Spinning-Warping Sub-total	10,780,845	341,959	462,878	9,460
1.0	Slashing	—	—	—	—
1.0	Weaving	24,098,472	723,621	1,984,909	28,306
	TOTAL:	113,507,853	2,861,916	6,787,199	93,758

NOTES

1) Equipment cost include air conditioning, 7½% consulting engineers fees, electrical wiring from main switch gear, and general construction of equipment rooms.

2) Maintenance cost are on air conditioning only and include spare parts, all calculated at 3½% of air conditioning cost.

3) Energy cost based on $116.50 per BHP per year (7200 hrs.). Air supply based on 100% operation for 7200 hrs. Refrigeration based on 60% operation for 7200 hrs. at an average load factor of 70%. ($116.50 × .60 × .70 = $48.93 per BHP per year).

4) The reason Opener & Picker Equipment Cost for .5 MG/M3 appear out of line with those cost for .2 MG/M3 is due to the reduced air quantity per mill costing more per C.F.M. and the reduced refrigeration tonnage per mill costing more per ton.

Exhibit 42

STATEMENT OF JACK W. WHITWORTH, M.D. MEDICAL DIRECTOR WESTPOINT PEPPERELL AMERICAN TEXTILE MANUFACTURERS INSTITUTE, INC. BEFORE THE PUBLIC HEARING CONCERNING THE PROPOSED CHANGE IN THE OSHA COTTON DUST STANDARD

My name is Jack W. Whitworth, and I am currently the Medical Director of WestPoint Pepperell. My statement will be primarily directed to our medical surveillance program, including its development, as it relates to the proposed standard on cotton dust.

I. DEVELOPMENT OF PROGRAM

In 1969 and 1970 we at WestPoint Pepperell became aware, from studies that were being carried out by various investigators such as Dr. Bouhuys and others, that there could be a correlation between cotton dust exposure and lung disease.

After corresponding with Dr. Bouhuys and searching the literature, particularly the British journals, we began to suspect that some of the pulmonary problems we had seen could represent symptoms of byssinosis. During the year 1970 a medical student was hired and trained to do pulmonary function tests. Some one thousand yarn manufacturing employees were tested and compared to some two or three hundred office workers, and we found that in fact there were some differences in lung function values in some individuals in the two groups.

The chronology of the development of our program from

this point was as follows:

1. Beginning in 1971-1972 dust level surveys were begun on a periodic basis-annually, or more often if a change in machinery and/or cleaning equipment occurred. Both personal and area samplers, including the vertical elutriator, were used.

2. Beginning in 1971, with more emphasis on pre-existing pulmonary problems such as asthma, allergies, more detailed pulmonary histories and pulmonary function tests were done as a part of preemployment examinations on prospective employees who were to work in areas where there was exposure to cotton dust. Potential risk employees were assigned to lower dust areas.

3. Beginning in 1971, before the development of our general medical surveillance program, registered nurses in each mill were taught the symptomatology of byssinosis and suspected cases were referred to the medical department for further evaluation and possible transfer to lower dust areas when indicated.

4. During 1972, in preparation for a general pulmonary survey, a slide presentation involving an explanation of byssinosis and reasons for upcoming pulmonary function tests, questionnaires, and chest x-rays was shown in each mill to the affected employees. We also published numerous articles in our company newspaper dealing with the subject.

5. In an effort to assure obtaining more consistent data, we elected to use a team approach to acquire pulmonary data. Accordingly, in 1972, five individuals were hired and trained in pulmonary function testing and instructed in giving the Modified British Research Council Respiratory Questionnaire (Schilling questionnaire).

6. We had some 9,000 employees at WestPoint Pepperell who were exposed to some concentration of cotton dust, and

in January of 1973 the team began a general pulmonary survey of this population. The surveillance program was carried out using standard procedures. A pre- and post-shift spirogram was done on Monday or first day back at work after an absence of approximately 40 hours from cotton dust exposure, using Jones Pulmonor II spirometers. The observed forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) were recorded in cc's, and using the Veterans Administration Cooperative Study (Kory) predicted volumes for age, sex, and height, the percent of predicted volume was recorded. The percentage (Δ) change between pre- and post-shift tests was figured. The standard questionnaire was administered during the same or the following week, and both the objective and subjective findings were keypunched for computer analysis. Byssinosis was graded, using the Schilling definitions of the grades of the subjective symptoms (historical byssinosis). Bronchitis, dyspnea, smoking, and chest illness were graded, using standard medically accepted definitions. Following the initial survey, those people with significant positive histories, low pulmonary function tests, and significant delta changes (10% loss or 15% gain) over the shift, were requestioned and retested. Some were retested on several Mondays or "first days back at work." The primary purpose for such retests was to try to establish the best individual baseline possible for future comparisons. Nevertheless, in a later discussion and analysis of the findings, only those responses obtained on the very first interview and pulmonary function tests done during the general surveillance program will be used. By this method we can maintain a credible epidemiological approach, so that a reasonable comparison can be made with other studies.

A respiratory protection program has also been adopted

by WestPoint Pepperell. High dust level areas have been designated by signs and employees working in these areas are informed that they will be furnished and required to wear respirators, either single use or replaceable cartridge type. Any person working outside these areas that so desires is also furnished a respirator free of charge. Explicit guidelines have been developed and furnished each affected employee.

II. ANALYSIS OF GENERAL PULMONARY SURVEY

In our first general pulmonary survey a total of 9,181 persons exposed to some level of cotton dust was studied. No one was excluded because of inability to perform perfect pulmonary function tests. Vigorous attempts to get the best possible data were carried out and most of the tests were felt to be reliable. We must remember, however, that for the great majority of the employees this was their first exposure to pulmonary function testing and it is well known that there is a learning curve for both the testors and those tested. In a continuing program such as this we do not have the luxury of being able to discard sub-standard tests, as is done in most epidemiologic studies. We got the best test possible and kept the results, because in the end we must be able to look not only at the group as a whole, but, for clinical purposes, at each individual as he or she progresses or degresses each year. I am convinced, as are most people who have ever done any pulmonary function testing, there is a very small percentage of individuals who will never be able to perform a completely satisfactory test. We must, however, keep the results for future comparison and hope that their same inconsistences are consistent each year. Then, at least we will be able to try to make some logical comparison. This is not said to excuse or defend a few poorer tests, but is a simple

statement of fact I am sure everyone has found in their initial surveys and is given as an explanation of why the pulmonary function test of each individual was included in our study. This will certainly make our findings look poorer, rather than better. The questionnaires were done without encouragement or discouragement by the individuals asking the questions, and only a simple explanation was given when requested and it was obvious that the question was not understood.

Of the 9,181 individuals studied, 124 or 1.35% gave positive answers to the questions related to byssinosis as graded by the Schilling method (Grade 1/2, Grade I, or Grade II). Of the 124 employees, 87 or 70.2% were Grade 1/2, 35 or 28.2% were Grade 1 and 2 or 1.6% (0.02% of all employees) were Grade 2. It must be stated and understood by everyone that we are talking here about *subjective* or "historical" symptoms. These classifications or grades by themselves are not, without more objective findings, indicative of any impairment or disability. This is particularly true in regard to Grade 1/2. In other words, a person can be in Grade 1 or 2 and have no objective evidence of disease. As was expected, the greater percentages of positive answers per number of people exposed per area were in yarn manufacturing (Opening thru roving) and this figure was 5.3%. Although spinning is considered a part of yarn manufacturing, it was separated for this analysis and showed 1.10% of positive symptoms. Yarn preparation (spooling, twisting, warping, and winding) showed 0.74%. Slashing and weaving showed 0.61%. Cloth inspection, shop (mechanics, electricians, etc., who work part of their time in the processing areas) and all others, showed 0.88%. These people were exposed to a wide range of dust levels from $< .2$ mg/M^3 to > 1 mg/M^3, as measured by

the vertical elutriator. Of the 1,120 employees working in yarn manufacturing (opening thru roving), 60 or 5.35% had positive responses to the questions relating to byssinosis. The mean dust level for each department was calculated and assigned the following ranges. The percentage of positive responses per number of exposed individuals in each range are as follows:

1. In dust levels from $<$ .2 mg/M^3 to .5 mg/M^3, 2.98% had positive responses.

2. In dust levels from .5 mg/M^3 to .75 mg/M^3, 5.4% had positive responses.

3. In dust levels from .75 mg/M^3 to $>$ 1 mg/M^3, 7.14% had positive responses.

Of the total number of employees (124) with positive symptoms in the entire survey, 60 or 48.38% were found in yarn manufacturing. Of these 60 individuals found in yarn manufacturing, 40 or 66.6% were Grade 1/2. Further, of those 60 individuals, 34 or 56.6% were in dust levels above 0.75 mg/M^3 and 26 or 43.3% were in levels below 0.75 mg/M^3.

Even though the population (1,120) in yarn manufacturing represents only 12.19% of the total survey population (9,181), we must recognize that this is the area of our primary concern. Our data showed that the majority of the individuals in Grade 1 were in yarn manufacturing. Therefore, in a medical surveillance program, particular emphasis should be given these areas, especially those with dust levels over 0.75 mg/M^3. So that no confusion or misunderstanding will arise regarding the 0.75 mg/M^3 dust level just mentioned, it must be understood that this is not recommended as the permissible exposure limit nor do we believe it to be the exact dose-response level. It is intended only as a point in the yarn manufacturing area at which medical

surveillance should receive more emphasis. We do not know the exact dose-response level nor does anyone else. Our study has the same inherent weakness in regard to dose-response predictability that all others have—dust levels prior to the study are unknown for those individuals who have subjective and/or objective byssinotic symptoms.

When equivalent dust level ranges in spinning are compared to those described in yarn manufacturing, the percentage of positive responses diminish greatly:

1. In dust levels from $<$ 0.2 mg/M^3 to 0.5 mg/M^3, 1.03% had positive responses.
2. In dust levels from 0.5 mg/M^3 to 0.75 mg/M^3, 1.41% had positive responses.
3. There were no dust levels above 0.75 mg/M^3 in spinning.

When equivalent dust ranges in yarn preparation (spooling, winding, twisting, warping) are compared to those described in spinning, the percentage of positive byssinotic symptoms diminish even further:

1. In dust levels from $<$ .2 mg/M^3 to .5 mg/M^3, 0.50% had positive responses.
2. In dust levels from 0.5 mg/M^3 to 0.75 mg/M^3, 1.36% had positive responses.
3. In dust levels from .75 mg/M^3 to $>$ 1 mg/M^3, 1.07% had positive responses.

Because of the abundance of starch in the atmosphere and the very low percentage (0.61%), of positive responses throughout weaving and slashing (0.6%), it was felt that no good comparison could be made except as a whole.

These data show that at some dust level between 1.0 mg/M^3 and .5 mg/M^3 of cotton dust the percentage of positive responses to the questions related to byssinosis drops sharply. These percentages are lower than those reported

in some other studies, but they accurately show the findings of our initial survey and it is our belief they more accurately represent the actual conditions.

As for objective finding or pulmonary function test results on the initial survey, 1,085 of the 9,181 or 11.8% showed a 10% Δ change or loss in FEV_1 comparisons between pre- and post-shift spirograms. The average FEV_1 % of predicted volume for the 9,181 employees was 86.5%. The average FVC % of predicted volume was 88.7%. We have approximately 40% black employees in our working population, and no correction factor for race was used at this point in time. Had the accepted correction factor of 12% to 15% been applied to the predicted volumes, these percentages would have been considerably higher. Moreover, as no individuals were eliminated because of substandard tests, these figures, on an epidemiological basis, would have been even higher.

On the initial survey the number of employees with a significant Δ % change over the shift was higher in (a) yarn manufacturing (opening thru roving) than in (b) spinning and the following operations. On repeat tests the percentage of employees with repeated significant Δ % changes in (a) and (b) dropped considerably (11.8% to 7.0%), but the ratio between (a) and (b) remained approximately the same. We believe the causes for these significant decreases in total percentages are improvements in testing techniques, and learning curves on individuals being tested. However, we also believe that portions of such decreases are because of improved work practices, improved cleaning systems, etc.

The most provoking aspect of the whole analysis has been the lack of correlation between subjective and objective findings. This, of course, is not a new thing and has been discussed in numerous articles. No totally complete explana-

tion has ever been given to our knowledge. The correlation between individuals who have both subjective or historical symptoms and objective or significant pulmonary function decrements in △ percentages (10% drop or more), has been less than 1% of the total population. Of the 6% who had significant △ changes (10% drop), only 10% also had positive questionnaires. Of the 1.6% (retest) who had positive questionnaires, only 30% had significant △ changes.

In the subsequent retests, both subjective and objective, the number of employees showing positive response to the questions on chest tightness or breathlessness contained in the questionnaire (Schilling Grades 1/2, 1, 2) have increased slightly, but the number of employees with significant 10% △ changes has decreased very significantly. On the initial survey the percentage was 11.8%. On followup, the percentage dropped to approximately 7% of the total population. There was a slight increase in the number of positive subjective or historical grades (1.35% to 1.60%). We feel that this was due to better understanding of the questionnaire or, in some cases, a conditioned response.

A conditioned response is defined as a situation in which answers to a questionnaire are exaggerated or understated because of reasons not related to health conditions. For example, an employee positively responds to the questionnaire in order to be subject to transfer.

We feel that Grade 1/2 byssinosis as defined by Schilling ("occasional chest tightness on Monday") is very tenuous and fuzzy to interpret at best. Textile workers smoke considerably more on the weekend and along with other weekend situations makes for having unrelated Monday symptomatology. In fact we have never been able to correlate Grade 1/2 consistently with anything and we think

erroneous analyses and diagnoses arise because of the vagueness of the Grade 1/2 definition.

III. DEFINITION OF COTTON DUST TOO BROAD

"Any dust" in a textile plant is not necessarily of cotton origin and should not be so broadly classified. For instance, we know in a weave room the dust level is primarily starch. In spinning we see typical dust levels of .2 mg/M^3 to .3 mg/M^3, and yet in the subsequent process—weaving—the dust levels may be .5 mg/M^3 to .7 mg/M^3. We know no one has dumped additional cotton dust in the weave room; therefore, the additional component in weaving has to be starch. It is a fact that the incidence of subjective byssinotic symptoms in the weave room is extremely low, and is lower (0.6%) than that found in any other area of yarn manufacturing and yarn preparation. In view of these facts, weave rooms and cloth inspection rooms should be allowed higher levels.

IV. RELEVANCE OF THE QUESTIONNAIRE AND PULMONARY FUNCTION TEST EVALUATION AS OUTLINED IN THE STANDARD:

There is no question that a questionnaire has some value as a diagnostic tool, but it has been recognized for some time that the most commonly used questionnaires in textile surveillance programs (Modified Research Council or similar) are subject to lack of uniformity in response. Some employees tend to minimize or exaggerate symptomatology. This may be done for a number of reasons. In order to achieve more consistent and open responses, we decided to try to develop an improved questionnaire. In 1975 we contacted Dr. Hans Weill of Tulane, and in a joint effort developed a modified questionnaire, which in our opinion, has definite advantages over the one in the proposed standard. We are

in the process of using this questionnaire now and hope to have a better evaluation of its results in the near future. We will be happy to share this questionnaire with OSHA for possible general recommendation.

Regarding pulmonary function evaluation, we feel that a 5% Δ change in FEV_1 over the shift as being significant is too stringent. It is our understanding that most ordinary spirometers are allowed a 2% degree of variance within the spirometer itself. This leaves only a 3% variation tolerance for the testor and the individual tested; and, we would feel confortable in saying that there is no pulmonary function team in existence that can repeatedly test to such degrees of accuracy. We have tested many individuals on several different Mondays under similar circumstances and sometimes they will have a 10% Δ change and sometimes they will not have any change. We are not certain that these individuals are true reactors. If they repeat the drop on several Mondays, this leaves less doubt. To our knowledge, there is no hard evidence that moderate reactors are at higher risk than nonreactors. We believe that the real emphasis should be placed on getting the best pre-exposure baseline pulmonary function tests possible, and comparing these results with succeeding pre-exposure results on a periodic basis. This is where the real proof lies.

Under the section on medical surveillance in the proposed standard, many statements are made which are ill-defined and unnecessary. The requirement that an individual with an FEV_1 of less than 80% predicted volume and a single delta change of 5%, be provided medical surveillance every six (6) months is unnecessary. With the test-retest variability, the idea of one 5% delta change over a shift requiring permanent placement of an individual on a six-month list has little validity and, if implemented, will cause

many unnecessary retests. Suppose this individual has a 0% delta change or a delta 5% increase in his next subsequent test. Do you continue to monitor this individual every six months or was the individual never a pulmonary function reactor?

The same section requires repeat testing every six months on an individual who has FEV_1 of 79% of predicted volume. Most surveillance teams use the Veterans Administration Cooperative Study (Kory) nomograms to compute the percent of predicted volume. There are many normal individuals not employed by the textile industry, as well as many employed by the textile industry, whose FEV_1 is 75% to 80%, and even 79%, or predicted volume using the Veterans Administration (VA) nomogram. The VA nomogram, however, admits to a standard error of estimate (SEE) as large as 0.52 liters on an FEV_1 prediction. Thus, at the very least, individuals whose FEV_1 was 75% to 80% of predicted volume in pre-employment testing, who had no history of asthma, allergy, chronic bronchitis, and who had not developed such history during their employment should have to be retested every six months if there is no change in their FEV_1 as their FEV_1 is clearly within allowance provided by the standard error of estimate. With the level of test—retest variability, we recommend that the level of significant Δ change be set at 10% and more emphasis be placed on annual decline rates.

V. PERMISSIBLE EXPOSURE LIMITS

In our opinion, the permissible exposure limits of 0.2 mg/M^3 is totally unnecessary. Our initial pulmonary survey data shows that the highest prevalence rate of positive byssinotic symptoms was found in yarn manufacturing. All other studies, to our knowledge, show similar findings. However,

our data presented here show a drop in occurence of positive byssinotic symptoms between 1.0 mg/M³ and 0.5 mg/M³ of cotton dust as measured by a vertical elutriator. In the area of most concern, yarn manufacturing, at a level of 0.5 mg/M³ of cotton dust, the percentage of positive symptoms was quite low.

As expected, our data show that the percentage of positive byssinotic symptoms are higher where the *cotton* dust levels are higher. However, our data also shows the percentage of positive byssinotic symptoms diminished considerably when equal cotton dust level ranges are compared in the progressive steps of the manufacturing process. We know that the dust level is inflated with starch in the slashing and weaving areas, but there are only minor dilution factors between carding and slashing except the man-made airborne fiber in blend mills. It would appear that the more active material is knocked out early in the yarn manufacturing area. A probable explanation for this phenomenon is that in the yarn manufacturing process most of the bract, leaf, and stem particles are separated from the cotton fiber and deposited or left in this area. As the later yarn manufacturing and yarn preparation processes speed up, a larger number of small, broken, fibers are slung out in the processes and are picked up by the vertical elutriator, adding significantly to the sample weight. Many investigators believe that the active agent in cotton dust is found exclusively in the bract, leaf and stem parts of the cotton plant, and that the lint or fibers do not contribute to any biochemical response in the lung. The addition of these small, micron size, non-active, broken lint fibers to the atmosphere may add to the sample weight, but not to the biologic activity of the dust.

Our data presented here show that at some level of cotton

dust between 1.0 mg/M³ and 0.5 mg/M³, as measured by the vertical elutriator, the percentage of positive byssinotic symptoms diminishes. At a level of 0.5 mg/M³ of cotton dust, the percentage of positive byssinotic symptoms is extremely low. With a good medical surveillance program, we are confident that those individuals with byssinotic symptoms can be positively identified, carefully monitored, and therefore be protected from symptom progression with use of respirators and/or transfers to lower exposure areas. A good pre-employment appraisal with particular emphasis on evaluation of pre-existing pulmonary problems such as asthma, allergies, chronic bronchitis, smoking habits, etc., along with careful pulmonary function testing is essential in a medical surveillance program. This allows for pre-placement of potential risk employees in low risk areas and certainly will diminish the number of people who become early reactors. A continuing medical surveillance program will then identify the few who develop any early reactivity over several years and allow for their protection prior to developing any permanent changes in their lungs. It should be emphasized strongly that early reactivity is reversible and not a permanent change.

Therefore, we recommend that the standard not be lower than 0.5 mg/M³ as measured by the vertical elutriator, and that respirators should not be required below this level except in those few individual cases identified as potential risks by subjective and/or objective symptomatology.

VI. CONCLUSION AND SUMMARY

1. "Cotton dust" as defined in the standard should be more meaningfully and more accurately defined.

2. The MRC questionnaire as outlined in the proposed standard should be reappraised and modified.

3. The 5% Δ change in FEV_1 proposed as significant in the standard, should more realistically be 10% and greater emphasis should be placed on observing the annual decline rate in FEV_1.

4. The proposed permissible exposure limit of 0.2 mg/M^3 is unnecessary to adequately protect individuals exposed to cotton dust, for a permanent permissible exposure limit of 0.5 mg/M^3 would provide adequate protection when coupled with monitoring and a thorough medical surveillance program.

5. The permissible exposure limit for cotton dust in slashing and weaving should allow for the abundance of airborne starch and other elements in the environment and, thus, should be considerably higher than in other areas.

Exhibit 47

STATEMENT OF HAROLD R. IMBUS, M.D., Sc.D. MEDICAL DIRECTOR, BURLINGTON INDUSTRIES, INC. AT THE PUBLIC HEARING ON THE PROPOSED STANDARD FOR EXPOSURE TO COTTON DUST

I am Dr. Harold Imbus. I am Medical Director of Burlington Industries. I joined the Company slightly over seven years ago and since that time I have been deeply involved with the Company's respiratory surveillance program. The Company's program has consisted of several aspects, namely:

1) Research and cooperation with universities, government agencies, and others, about the nature, incidence, and correction of the byssinosis problem.

2) An on-going medical surveillance program which involves testing of employees and prospective employees in plants where cotton yarn is spun.

3) An extensive program of dust monitoring.

4) A program aimed at lowering dust levels and exposure by engineering controls, work practices, and respirators.

My primary emphasis here will be on the medical surveillance program and results thereof because it is the area that I have dealt with mostly. In the other aspects the Company has an extensive capital improvements program to control dust. Further, our Dr. Moon Suh will discuss some research and statistical aspects of prevalence of the symptoms of byssinosis and Dr. John Neefus from Burlington Industries will discuss some aspects of environmental monitoring.

Our medical surveillance program primarily consists of 1) pulmonary function testing and 2) questionnaires, on a

yearly basis, for all employees, and prior to the time of employment for applicants. Employees of special concern after this testing are referred to independent medical consultants for evaluation and recommendations. We have approximately 12,500 employees included in the program who are tested each year, in addition to preemployment testing of applicants, and have administered well over 100,000 tests since the beginning of the program in 1970. Testing and minor counseling is performed by the plant nurse. Cases of more concern are seen by a member of the corporate medical staff in Greensboro. To date, over 3,000 such individual interviews have been conducted by our corporate staff. Three hundred sixty-seven (367) of these individuals have been referred to independent consultants.

In our original study [1] we found 460 out of 10,133 employees or 4.5% who complained of the Monday chest tightness which defines the byssinotic reactor under Schilling's definition. It should be emphasized that these were individuals complaining of tightness in the chest on Monday and were not necessarily disabled or impaired—in fact, the majority of these individuals were not impaired or disabled. In addition, we found substantial declines for a number of employees in the one second forced expiratory volume (FEV_1) from the beginning to six hours after the beginning of the shift. As the study indicates, a significant number of employees showed the symptoms of being byssinotic reactors based on their answers to the questionnaire and there was evidence of substantial pulmonary function reactivity in the various departments.

Table 1 illustrates some of the progress that has been achieved as a result of our program. In our 1976 survey, we had 136 employees or slightly more than one percent (1.0%) complaining of the Monday tightness of byssinosis

reaction versus the 4.5% in 1971. In 1976, the average change in FEV_1 from before to during the shift for all tested employees was 0.00% versus —1.7% in 1971. For preparation areas in 1976 it was —0.54% versus —3.9% in 1971. Similar improvements are observed in yarn production, slashing, weaving and other areas. In 1971, approximately 18% of our employees tested showed a drop in their FEV_1 of 10% or more. In 1976, that figure was 7.4%, which is about the same as the number whose FEV_1 increased by a similar amount. I might add that our figures in respect to FEV_1 drop of 10% or more tend to be somewhat higher than others since we do not eliminate unsatisfactory results from our composite reporting as is customary in most research or epidemiological studies.

Dust reductions have helped. However, these marked improvements in symptoms and functional readings have been achieved in the face of the fact that only 28% of our areas (in most naturally low dust operations such as roving through spooling of blends) are at or below .2 mg/M^3, while 38% are between .2 mg/M^3 and .5 mg/M^3 and 34% are still above .5 mg/M^3. As we bring all yarn production areas to .5 mg/M^3 or below in coming months it is my opinion that there will be very few reactors left at all.

In addition to improvement brought about by lowering of dust levels, we believe that considerable improvement has been accomplished by:

1) Placement of healthy employees in cotton operations.

2) Transfers where feasible.

3) Wearing of respirators for susceptible employees and those working in the higher dust levels.

4) Counseling with employees regarding smoking, and early identification of and getting employees with early chronic lung disease under a program of care.

Byssinosis can and does result in chronic obstructive lung disease. We have certainly found evidence of this in our own Company and have reported so. However, if byssinosis resulting in chronic obstructive lung disease were as rampant as some lead us to believe, one would expect evidence of a very high incidence of chronic obstructive lung disease in the U.S. cotton textile industry. We have considerable evidence to the contrary. Dr. Hans Weill [2] in a Tulane University study of several textile mills concluded "no excess of chronic obstructive pulmonary disease was detected in this population as indicated by low bronchitis prevalence and baseline pulmonary function measurements which compare favorably with expected values."

We have evaluated our results and have compared them with a study of an unpolluted Colorado city [3]. In that study, criteria of chronic obstructive lung disease was an FEV_1/FVC ratio of less than 60%. In the Colorado study, the overall incidence of chronic obstructive lung disease in 609 persons was 6.8%. The comparable figure in 12,519 Burlington cotton plant employees in 1976 testing was 2.4%.

I know that there are individuals who have serious chronic obstructive lung disease who have worked in cotton textile mills. One tends to assume the relationship between their work and their disease. This may or may not be so. One need only visit a respiratory clinic, however, to find many people suffering from a terrible disease, obstructive lung disease, which has reached epidemic proportions in our country. These people are from all walks of life, many who have never worked in a cotton mill and many who have lived and worked in nondusty environments. I make these remarks to in no way minimize the importance of byssinosis, but to put it in perspective.

The proposal for a .2 mg/M³ or lower permissible exposure limit for cotton dust is based to a large extent upon the study done by the Duke/State of North Carolina [4] group which indicates that allowance of the .5 mg/M³ level is tantamount to allowing 26% of the employee population to develop symptoms of byssinosis, with for a .2 mg/M³ level, the comparable figure of approximately 13%. It must be remembered that these figures are for historical byssinosis which is based solely upon Monday symptoms which are determined solely by a positive subjective response to a questionnaire, and do not indicate irreversible disease.

Let us look at the results of some other studies. I have already mentioned our data with respect to past and present prevalence. Dr. Moon Suh expands on this discussion in his statistical analysis which reveals a 6% prevalence of historical byssinosis symptoms as determined by questionnaire at .5 mg/M³.

In the textile manufacturing industry, several companies with active medical programs pooled data on the incidence of historical byssinosis (Grades 1/2, 1 and 2) on initial surveys. This represented an original questionnaire survey of 41,283 employees. Table 2 summarizes the findings. Overall incidence of all grades was 1.79%. The highest overall percentage incidence was in preparation (opening through roving), 4.3%. In not all cases were dust levels done at the time of the medical survey; however, it was possible to assign dust levels for approximately half, or 20,027, of these employees. Of these, 6,855 employees were working in dust levels above .5 milligram per cubic meter. Overall incidence was 3.17% byssinosis symptoms for this group, with the highest incidence, 31.9%, in drawing, and an average of 11.29% for 1,488 employees working in preparation. Weaving, which represented 4,265 of these employees,

had an incidence of 0.6%. Another group of 13,172 employees worked in dust levels at .5 milligram and below. Overall incidence of all the historical byssinosis for this group was 1.32%, with approximately 14% in roving and averaging 4.41% of 1,566 employees in opening through roving. Incidence in weaving was 0.7%. A third group of 21,256 employees for whom no dust level was assigned had an incidence of all grades historical byssinosis of 1.63%. Highest incidence was 5.1% in the opening and picking area, with an average of 2.38% of 5,537 employees in opening through roving. There was an incidence of 1.4% in weaving. Three thousand five hundred thirty-eight (3,538) of these 41,000 employees showed a drop in FEV_1 of 10%, or a total of 8.57%. More detailed summary of individual work areas is submitted in an Appendix to this report.

A survey done by the ATMI in December, 1976 revealed that approximately 150,000 textile employees work in areas where they might be exposed to raw cotton dust. The survey which I have just cited of approximately 41,000 employees, therefore, represents over one/fourth of this population. Projecting the 1.79% of these employees to the U.S. cotton textile employment of 150,000 reveals that approximately 2,700 employees would be expected to have subjective symptoms of byssinosis, that is, Monday tightness. It is obvious from these figures that some of the projections by whatever means measured have been grossly exaggerated. Now, the above data indicates that, even after combining all those exposed to .5 mg/M^3 and more, the employees with a potential problem are less than one/third of those projected by the Duke/State of North Carolina study at .2mg/M^3. Thus, I think it would be helpful here to review some of the various studies on a number of other investigators.

The NIOSH "Criteria for a Recommended Standard-Oc-

cupational Exposure to Cotton Dust" reviews findings of various investigators with respect to correlation of cotton dust exposure and incidence of historical byssinosis. Most investigators have found an association between dustiness and incidence; however, to quote the document, "the slopes of the prevalence dustiness curve obtained by different investigators vary considerably." Thus the studies of Merchant [4] et al. and Molyneux and Berry [5] report prevalence of 13% and 10% at .2 mg/M³ and 26% and 40% at .5 mg/M³, respectively, while those of Fox [6] report a prevalence of 6% at .5 mg/M³, and a 40 year expected prevalence of 10% at .5 mg/M³. Our own studies revealed marked differences in prevalence per given dust level in various plants. Also, generally a tendency to have higher prevalence per unit amount of dust was found in the preparation areas, versus the yarn processing areas; more where coarser cotton versus finer cotton is used, and more where all cotton versus cotton/synthetic blend is used.

Work reported subsequent to the publication of the Criteria Document includes that of Noweir [7] who found a prevalence of 7.1% historical bissinosis among 506 cotton textile workers where respirable dust levels ranged from .10 to 2.35 mg/M³ but were mostly above .26 mg/M³. More recent work done in Australia by Barnes and Simpson [8] indicates a prevalence of 2.4% of 493 workers, though levels did reach up to 8 mg/M³ *total dust*. The authors seemed surprised that they were not able to find a higher incidence after having read the American and British literature.

The point that is made by a comparison of the different results of these different investigators is that there is no dose-response curve applicable to the textile industry per se; that dose-response varies in many different situations. There-

fore, any attempt to extrapolate from dose-response data of a single investigator and apply it to the American Textile Industry is simply not valid. Moreover, all studies suffer from the same failing as far as determining a dose-response curve is concerned—there was absolutely no data which was available which showed the dust levels to which employees were exposed *prior* to the study.

Burlington Industries made its plants available for study of the byssinosis problem by the investigators from Duke and the State of North Carolina. It is this study which is widely cited as the reason for the proposed .2 mg/M^3 standard. Summary and individual results were given to our medical department for follow-up. After it was determined by the investigators that byssinosis did exist in our plants, we established an annual pulmonary function questionnaire screening program so that individual employees could be evaluated. This, therefore, offered opportunity for comparison of our results with the investigators'. Table 3 presents the comparative results of two plants used for illustrative purposes.

The results presented from Plant 1, which was a very dusty plant, are not entirely comparable in that steaming experiments had been done in this plant. However, steaming was stopped prior to widespread equipment changes which resulted in lower dust levels. Prior to these changes we took a survey of the day shift employees. As you can see, overall, we found 17% incidence of symptomatic byssinosis versus 27% from the Duke/State of North Carolina investigators. Actually, in preparation area our findings were 30% versus their 41%. Though there were some differences, we do not feel they were striking or not readily explainable by possible changes in personnel, equipment, survey technique, etc. These results are published in the *British Journal of Indus-*

trial Medicine [9].

The case with Plant 2 is entirely different. In 1971, the Duke/State of North Carolina group found 19.5% historical byssinosis in the preparation area and a total of 6.2% throughout the plant. Subsequent surveys performed by us revealed 0 percent byssinosis. Our first reaction of course was to question our own techniques to see that questionnaires were being properly administered. However, in subsequent years, the results were the same. This plant has remained essentially unchanged since the original survey and has dust levels in the .4 to .6 mg/M^3 range. In contrast to the first plant, it is a blend plant.

We were somewhat concerned about the wide disparity that the different investigators obtained in this plant, while on the other hand, there did not seem to be such a glaring difference in the other plant (Plant 1). We reviewed the results given to us by the Duke/State of North Carolina group and found that in the first plant, the Plant 1, only 44% of the cases were diagnosed as being Grade 1/2, whereas in the Plant 2, seventy-one percent (71%) were Grade 1/2.

I believe that the use of Grade 1/2 pooled in with the percentages of those having historical byssinosis as a means of arriving at a dose-response curve has severe limitations. We feel that the validity of such dose-response curves and their validity as a means of setting a standard are open to challenge. Grade 1/2, in our experience, has not been very reproducible, even with the same investigator, and has been open to wide variations of interpretations by different investigators. Furthermore, it is a projection of such investigation as done at the Plant 2 onto a nation wide basis that leads to the erroneous assumption that many thousands have byssinosis.

In addition, we were able to take some of the cases who had been diagnosed as having byssinosis at Plant 2 original study and refer them to Dr. Mario Battigelli for evaluation. He will report on his negative findings of byssinosis in this testimony.

Another question I would like to deal with is the question of reversibility of byssinosis. When we see figures of incidence of byssinosis, for example, 25% in certain areas, it is natural to assume that this represents one/fourth of the people having significant illness. I believe we would all agree that these people are at increased risk of illness when they develop this periodic chest tightness and/or pulmonary reactivity. However, many of these people exhibiting this are not in any way ill. The question arises, can you detect these people at a substantially early stage to keep them from developing significant irreversible lung disease from their cotton dust exposure. We think we can and we have several tools in order to do this:

1) The questionnaire - periodic chest tightness. Although all our experience and data indicate little confidence in the Grade 1/2 or occasional byssinotic symptoms, the consistent complainer of a Grade 1 or 2 symptom as defined by questionnaire has, in our experience in many cases, been quite reliable.

2) Pulmonary function reactivity, that is a decrement of FEV_1 of 10% or greater is also an indicator. We do not believe that a single drop of this magnitude, but a consistent demonstration of such drop, would be a hallmark of a possible future problem.

3) Finally, and apparently ignored in the proposed standard, is serial determinations of pulmonary function, that is following people from year to year and determining whether they are losing pulmonary function at a faster rate

than they should. We believe that with proper utilization of these three tools it is unlikely that an employee will suffer damage from cotton dust without early detection.

However, one major factor must be recognized. Approximately 50% of our employees smoke. Smoking is associated with chronic obstructive lung disease which pathologically is indistinguishable from the chronic bronchitis of byssinosis. Studies have revealed general incidence of chronic obstructive lung disease of 10-20%, or more. Therefore, we are going to have chronic obstructive lung disease, completely unrelated to byssinosis, no matter what we do. However, we believe that our program can in the long run substantially reduce this. We have been able to get a number of employees to stop smoking, to have better habits of care and to be detected at an early stage wherein they would not be otherwise. The average chest physician who sees a case of chronic obstructive lung disease sees it at a very late stage. It is therefore our policy to refer an employee working in cotton dust to a chest physician, at company expense, when he is exhibiting signs of developing chronic obstructive lung disease regardless of the suspected etiology.

I would also like to comment on several other aspects of the proposed standard. Compulsory wearing of respirators above .2 milligram would in my opinion be disastrous to employees, to companies and to OSHA. Well over 100,000 textile workers would be in respirators. What is so tragic about this is that it is not necessary. There are literally thousands of employees working in dust levels between .2 and .5 mg/M^3 who are showing no effect day in and day out. To require them to wear respirators because of an arbitrary number would just not be fair to them. We concede that there would be some level above which you must protect all employees, even at the risk of protecting some who may not

need it. This should be kept to a minimum. We would suggest .5 mg/M^3 for such a level, and would suggest compulsory wearing of respirators for reactor employees below .5 mg/M^3.

It is difficult for me to understand why OSHA precludes the use of the single use respirator, particularly as NIOSH has approved their use. Two of these in particular now on the market are proven effective. Others in testimony here also indicate their effectiveness. It is very true that improper wearing of these respirators, breaking of straps, etc. can obviate their effectiveness. However, a protective device which is best is the one that is worn, and these are more apt to be worn than the very uncomfortable permanent respirators that are proposed in the standard.

Another problem that I notice with the proposal is Section H(5)(i)(A). Requiring a physician's written opinion for each employee is an extremely difficult requirement. I believe that most authorities in this field agree that paramedicals, that is, trained nurses and others can administer these examinations. We all agree that they should be under general supervision of a licensed physician, preferably one experienced in this field. However, there is no need for the physician to see every employee, and to require the physician to provide an individual written opinion with respect to an employee that he has never seen, places him in considerable jeopardy from a medio-legal standpoint, and also provides a great deal of administrative difficulties. We operate cotton plants in six states and we train our nurses in our program. We supervise carefully by periodic visits, quality control, immediate availability of consultation by telephone, etc. However, to have a physician write a note for each employee in each of these states would be administratively and legally not feasible. We could not expect to rely upon local physicians to provide this service. I believe

with the current malpractice situation, they would be reluctant. They certainly are too busy doing other more productive work to get involved with additional unnecessary paper work.

I would like to make one last comment which concerns the OSHA definition of cotton dust. OSHA is faced with a difficult problem here since the causative agent is not known and since there are no practical field methods for differential analysis between the dust that is generated from cotton itself and other types of dust such as from air pollution, synthetic dust, size, etc. I can concur with the practical utilization of the OSHA definition. However, if one is to use a definition, then one must set reasonable dust level standards.

For example, it is not unusual, as OSHA has indicated the Preamble to the Standard, to have community dust levels approaching .1 milligram per cubic meter. A standard therefore of .2 mg/M^3 may be represented by half dust not generated from the process itself. Likewise, in weaving, a large percentage of the dust would be due to sizing. Therefore, OSHA's definition is only logical to use when relatively achievable total airborne dust levels are set as the standard; in this case for most applications, with the exception of weaving, .5 mg/M^3. For a standard as low as .2 mg/M^3, I would consider it absolutely necessary to revise this definition to make correction factors for the presence of synthetic, size, and community dust levels.

In conclusion, I believe that there is a problem of byssinosis in the United States. It is my opinion, based upon our experience, that a standard is needed for respirable dust levels. The standard should include control of dust levels. In my opinion, a level of .5 mg/M^3 combined with an active medical surveillance program and a program involving transfers, respirators, counseling, and assistance to the susceptible employee would be appropriate, generally achiev-

able and protective of the employee. The standard should be somewhat higher in weaving. The cotton dust standard has been a most difficult one for OSHA to develop and will present additional difficulties after weighing all of the evidence presented at this hearing.

REFERENCES

1. Imbus, H.R., Suh, M.W.: Byssinosis—A Study of 10,133 Textile Workers. Arch Environ Health 26:183-91, 1973.

2. Weill, H.: Report to the American Textile Manufacturer's Institute on a Study Entitled Assessment of Respiratory Response in Textile Workers Exposed to Low Levels of Cotton Dust. Tulane University School of Medicine, May 31, 1976.

3. Mueller, Robert E., Keble, David L., Plummer, Jerry, Walker, Strother H.: The Prevalence of Chronic Bronchitis, Chronic Airway Obstruction, and Respiratory Symptoms in a Colorado City: Amer. Rev. Resp. Dis., Vol. 103, pp. 209-228, 1971.

4. Merchant, James A., et al.: Dose Response Studies in Cotton Textile Workers. J. Occ. Med., Vol. 15, No. 3, March, 1973.

5. Berry, G., Molyneux, M.K.B., and Tombleson, J.B.L.: Relationships Between Dust Level and Byssinosis and Bronchitis in Lancashire Cotton Mills. Br. Ind. Med., 31, 18-27, 1974.

6. Fox, A.J., Tombleson, J.B.L., Watt, A., Wilkie, A.J.: A Survey of Respiratory Disease in Cotton Operatives—Part II. Symptoms, Dust Estimations and the Effects of the Smoking Habits. Br. J. Ind. Med., 30:46-59, 1973.

7. Noweir, M.: Epidemiological Studies in Cotton and Flax Industries. High Institute of Public Health, University of Alexandria, Alexandria, Egypt, U.A.R. The American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1975.

8. Barnes, Robert, Simpson, G.R.: Variations of Pulmonary Function Amongst Workers in Cotton Mills. J. Occ. Med. Vol. 18, No. 8, August, 1976.

9. Imbus, H.R., Suh, M.W.: Steaming of Cotton to Prevent Byssinosis—A Plant Study. Br. J. Ind. Med. 31:209-219, 1974.

TABLE 1

	1971					1976				
	Prepara-tion	*Yarn Produc-tion*	*Slash Weave*	*Other*	*Total*	*Prepara-tion*	*Yarn Produc-tion*	*Slash Weave*	*Other*	*Total*
Number	1126	2642	2402	2015	10,133	1889	3682	4295	2653	12,519
Byssinosis %	18	3.7	2.1	1.8	4.5	3.65	0.95	0.44	0.53	1.09
△ FEV $_1$% (After—Before)	−3.9	−1.5	−1.5	−1.0	−1.7	−0.54	−0.18	+0.09	+0.45	0.00

TABLE 2

TEXTILE INDUSTRY RESPIRATORY SURVEY OF 41,283 COTTON TEXTILE EMPLOYEES

	No. Employees	*Byssinosis (All Grades)* *No.*	*%*	*Δ FEV₁ > 10%* *No.*	*%*
All Employees	41,283	737	1.79	3,538	8.57
Preparation (opening thru roving)	8,591	369	4.30	886	10.31
Dust Level Assigned	20,027	391	1.95	1,623	8.10
> .5 mg/m³	6,855	217	3.17	778	11.35
Preparation only					
> .5 mg/m³	1,488	168	11.29	337	22.65
≤ .5 mg/m³	13,172	174	1.32	845	6.42
Preparation only					
≤ .5 mg/m³	1,566	69	4.41	144	9.20
No Dust Level Assigned	21,256	346	1.63	1,915	9.01
Preparation only	5,537	132	2.38	405	7.31

TABLE 3

COMPARISON OF FINDINGS OF PREVALENCE OF BYSSINOSIS OF DIFFERENT INVESTIGATORS IN TWO BURLINGTON INDUSTRIES PLANTS

Figure in [ ] is Number

	Plant 1 *% Byssinosis by Area* *Duke/N.C.*		*B.I.*	
Preparation	41	[112]	30	[33]
Yarn	21	[245]	10	[67]
Total Yarn + Preparation	27	[357]	17	[100]

	Plant 2 *% Byssinosis by Area* *Duke/N.C.*		*B.I.*		*W. Virginia*	
Preparation	19.5	[41]	0	[32]	0	[41]
Yarn	1.9	[159]	0	[101]	0	[86]
Total Preparation + Yarn	5.5	[200]	0	[133]	0	[127]
Total Including Weaving	6.2	[340]	0	[264]	.45	[449]

Exhibit 63

STATEMENT OF JOHN P. FIGH VICE PRESIDENT AND TECHNICAL DIRECTOR TEXTILE INDUSTRY CHASE MANHATTAN BANK, NEW YORK BEFORE THE PUBLIC HEARING CONCERNING THE PROPOSED CHANGE IN THE OSHA COTTON DUST STANDARD

My name is John P. Figh and I am Vice President and Technical Director, Textile Industry, at the Chase Manhattan Bank, N.A. I have spent twelve years with Chase Manhattan as the textile consultant, both within the bank and to our customers, on all aspects of the textile industry.

I have a BS degree in chemical engineering from Auburn University and a MBA from the Harvard Graduate School of Business. Before joining Chase in 1965, I had approximately ten years diversified experience within the textile industry.

My testimony involves the financial implications for the textile manufacturing industry to comply with the proposed cotton dust standard, with particular emphasis on the ability to finance the capital expenditures required to comply with the proposed standard.

In 1975, textile manufacturing industry sales, including cotton products, were over $35 billion with approximately one million people employed. In the U.S., textile manufacturing is geographically located in the Southeast. Textile plants in the Carolinas, Georgia, and Alabama, account for the bulk of spinning, weaving and knitting operations.

The industry, according to government figures, is made up of more than 5,000 companies. Since most of these are small (4,300 have less than 100 employees), the industry

is highly fragmented. The largest company in the industry, with sales over $2 billion, accounts for only seven percent of sales. The second largest is only about 60% this large.

No one company is dominant either in the industry or in any major segment. While in the past it has been relatively easy for a textile company to enter a new field, it is becoming increasingly more difficult. As a matter of fact, there has been some recent consolidation by industry product line.

During the 1950's and 1960's, textile companies grew through merger. However, because of pressure from the Federal Trade Commission (FTC), during the 1970's merger and acquisition activity has been limited. In 1974, the FTC rescinded its merger guidelines and it is possible that some of the less diversified companies will use this route to strengthen their economic and market position, though to date there has been little activity in this area.

Because of the competitive nature of the textile industry, earnings and return on equity of textile companies have been traditionally lower than many other industries. After tax, earnings on sales over the last five years have averaged 2.4% compared to 4.7% for manufacturing in general and return on equity has averaged 7.2% compared to 12% for all manufacturing.

While it is possible that there may be a small improvement in textile profits, it is unlikely there will be a major change between 1977 and 1985. The competitive factors remain unchanged and there is sufficient capacity to supply anticipated demand.

Moreover, it must be remembered that in addition to being a cyclical industry, the textile industry is subject to style changes. Large, highly diversified manufacturers tend to average out this factor; for example, when spun wovens

are strong and profitable, demand for filament knits might be soft. This leaves smaller, less diversified companies in a potentially vulnerable position.

Overall, it appears that the large, more diversified manufacturers will grow at the expense of smaller companies. The trend toward concentration in market share by product line is also expected to continue.

The next few years should see an above average growth in the consumption of products made by the textile industry. On a unit basis, we estimate that domestic consumption of textile products over the next five years will grow at a rate of 4% to 4½% a year. For our domestic industry, however, this growth will be tempered by the fact that imports affect only certain areas and those to varying degrees. For example, sheets and towels are primarily domestic while certain low-priced apparel has been under continual pressure from overseas competition.

Therefore, and keeping in mind the imports problem, on a broad base, Chase is projecting an average unit growth of 3½% per year for the U.S. textile manufacturing industry for the next five years.

What I think is significant here is that by continuing to upgrade plants with the most modern and efficient equipment, the textile manufacturing industry will likely not be required due to demand to add much in the way of new bricks and mortar. There may be some individual cases of out-of-date facilities being replaced by new buildings; but for the most part, I believe we will see more in the way of modernization of existing plants, particularly in light of the vast increases in construction costs.

As for new machinery, evolutionary changes are continuing at what appears to me to be about the same rate as in the last few years. There does not appear to be any vast new

technology on the horizon. Even if there were, it would take some time to achieve acceptance. For example, open-end spinning, which was first shown in the late 1960's, is just now being accepted and has not in any way made ring-spinning obsolete.

In sum, with the moderate expected domestic textile growth and new machinery presently available, the textile industry should be able to absorb this growth within the confines of its present plan—and with less direct labor. However, to be competitive, more and more less efficient production machinery will have to be replaced by the most modern equipment currently available.

If the question of improvement in equipment was the only factor, the greater part of this could be financed by conventional methods. Depreciation, retained earnings, careful control of inventory and receivables as well as prudent use of debt should generate enough funds for a well-manned textile company to be competitive and to remain as profitable as the overall textile manufacturing industry.

However, this does not address another extremely important aspect of the textile economic situation which we are here to discuss today. To meet the proposed cotton dust standard, the Research Triangle Institute (RTI) statement suggests that $2.58 billion will have to be spent on non-production equipment by the industry over the next seven years. That would amount to about the total the industry spent on all capital projects of all types over the last 3½ years or, stated another way, almost the last 4 years of total after-tax earnings for the industry. And that is for cotton dust control alone—let alone the many other issues such as noise control with which the industry is confronted.

Now what does all this mean, and what will be the impact on the industry? First, let's look at the ways it has to raise

money. There are five major sources of capital generally available to industry:

1. Public offerings of stock or other equity instruments.
2. Public offerings of long-term debt.
3. Private placements of long-term debt with insurance companies and other institutions.
4. Intermediate bank debt.
5. Internally generated funds.

Unfortunately, in none of these areas does the textile industry stack up particularly well. Only a few public companies have access to equity markets. Many large textile companies sell at low price-earnings ratios and often well below book value.

Public issues of notes and books have much the same problem as equity, plus the fact that smaller public companies are unlikely to have access to this market.

Private placements have a greater appeal, but even here, there are limits to the amount of debt a company can manage. Many textile companies are already pushing prudent limits.

The next area, medium term debt from banks, also offers some possibilities. But there is still the question of how much additional debt would be prudent for a textile company to expect to obtain from commercial banks.

As for the last source (internally generated funds), the textile industry, as mentioned earlier, can fully exhaust depreciation and profit, less a certain amount to give stockholders a return on their investment, just to keep up technologically.

It is easy to see that the public companies that have invested the most in new machinery generally have been most profitable. Moreover, there are still too many companies that have a lot of catching up to do. As a matter of fact, we could make the point that the textile industry has been

going backward by standing still. In the 1960's, new plant and equipment expenditures peaked in 1966 at $820 million. Then, from 1967 to 1973, the range was between $530 million and $770 million. In 1973, spending reached $840 million, and is estimated at $840 million for 1976. While, of course, it is not really possible to compare 1966 machinery with 1976 machinery either in efficiency or price, there is absolutely no question that 1966 dollars would go much father than 1976. The important fact remains that the textile industry must fully utilize its resources and capital just in keeping up technologically in the production of yarn and fabric in the face of worldwide competition.

However, there is another extremely important aspect to this situation which we are addressing ourselves to today. Most of the larger companies are well diversified, often with man-made fiber products accounting for well over 50% of their sales. These products are not subject to the cotton dust standard. Moreover, the larger diversified companies have marketing expertise and flexibility to adapt to changes in manufacturing and markets. If for some reason it should not be feasible to produce products of 100% cotton because of inability to meet OSHA regulations, those companies have the financial resources to utilize existing facilities to produce replacement products. In other words, if cotton were eliminated completely, the bigger companies would stay in business.

However, there are a substantial number of companies, and no one is sure exactly how many, with sales in the range of 10 to 50 or perhaps 60 million dollars annually which are predominately cotton mills. Often, these companies produce either 100% cotton yarn or blends of cotton and polyester, which is sold throughout the industry to weavers and knitters. Some of these smaller companies also weave cotton

fabrics. These smaller companies often operate in older mills with 100% of their products manufactured from cotton in some form or another. It is these mills that will bear the largest proportionate share of the proposed 2.5 billion dollar expenditure. While at this stage it is impossible to quantify the effect on a particular company or group of companies, I am certain that many plants would not be able to comply with the standard, either from lack of economic resources or from the fact that the investment to bring an older mill up to standard would make them uncompetitive with the larger companies who have newer plants, greater resources, and better access to the latest technology.

Certainly, then, there would be some closing of plants and possible bankruptcy with resulting unemployment, often in smaller communities whose economics are dependent on the local textile plant.

Over the long run, what would happen is that many smaller companies would be faced with either liquidation or forced into merging into the larger companies that can spread out their share of this capital investment.

Really, the significance here is that the 2.58 billion dollars estimated by RTI as required to be spent over 7 years to meet the cotton standard would fall disproportionately on a group of plants utilizing cotton, which represents about 30% of total fiber consumed by the textile industry.

In summary, we are left trying to determine the ability of a segment of the textile industry to secure $2.58 billion to purchase equipment which at best will be simply non-productive.

Experience of the past indicates that the industry is already having to spend more for fixed assets than is provided by depreciation. The competitive world market, price inflation, and increasing government restrictions indicate

that this need for funds is likely to increase even further.

An increase in basic consumer demand plus the impact of price inflation should also be expected to continue, requiring that substantial amounts of cash flow be used to support growth in inventory, receivables and other assets required by increased sales volume.

Since over 90% of the companies in this industry do not realistically have access to the longer term capital markets, and given that internally generated cash flows have already proven inadequate to meet existing needs in many instances, bank debt is left as the only remaining alternative.

Therefore, in my judgment, while we have to take each case individually, it will be impossible for many companies within the industry to obtain the funds, either through bank debt or otherwise, needed to handle their share of this additional $2.58 billion burden.

[102] * * *

QUESTIONING OF GROVER WRENN

BY GEORGE PERKEL

Informal Public Hearing on Proposed standard for Exposure to Cotton Dust, April 5, 1977.

* * *

Mr. Perkel: But is it not true that when you proposed the seven year delay, it was based partly on the RTI document and partly on the letter from the RTI chief investigator to you, which is cited in the Preamble, in which he estimated [103] that it would take about seven years for the particular types of retrofitting that were developed in the RTI study to be designed and installed. So that that seven year figure is based entirely upon the retrofitting solely, is that not true?

Mr. Wrenn: It is certainly based upon the documents which you cited. They again, I think, conclude that the retrofitting strategy is the one that would most likely be followed. I think it remains to be clarified the extent to which alternative strategies are likely to be available and conceptually it would appear as in much of other human endeavor, if you provide a multitude of choices, the time required to implement them collectively conceivably could be less than all if the industries were confined to a single choice for achieving compliance with the standard.

[2488] * * *

QUESTIONING OF HOVAN HOCUTT

By Robert Hughes

Informal Public Hearing on Proposed Standard for Exposure to Cotton Dust April 28, 1977.

* * *

Mr. Hughes: Okay. So I would take it then without telling me what these things are that you are looking into innovations or better technology?

Mr. Hocutt: We have been doing that, Bob, for 30 years and we will do that for the next 30 and there is nothing unusual about that and it goes at an agonizingly, expensive, slow pace.

[2489] Mr. Hughes: I think as was mentioned earlier, with the incentive of a large standard that this would, perhaps, get—

Mr. Hocutt: It will only excelerate if I may anticipate your questions, Bob, by the way the business grows. We are never going to spend more money than we spend now percentage wise for research in the textile industry. The textile industry is not a growth industry as far as we are concerned.

All the new money that we put into R&D is going into wood dust control and grain and speciality air conditionning products and we are frantically looking for some other things and the first requirement is that they are not in the textile industry. And, you see, when we get around to producing against whatever standard you people propose, we are certainly not going to expand our plant. The last thing we will do is to make a big investment, a capital investment to increase capacity in a business that is going to go X years and then run off the cliff. So you see there is a very limited incentive for research in our type of business and we will proceed within those limits.

[2514] * * *

QUESTIONING OF HOVAN HOCUTT

By George Perkel

Informal Public Hearing on Proposed Standard for Exposure to Cotton Dust April 28, 1977.

* * *

Mr. Perkel: If the demand for the services of your company were to increase, would you not increase your capacity?

Mr. Hocutt: I am assuming you are talking about for lint and dust controls, for the textile yarn manufacturing industry. Is that correct?

Mr. Perkel: I am not limiting it to the yarn industry.

Mr. Hocutt: I cannot answer the question because there are many factors involved more than some increase in demand. Longevity is very important for capital investment. We don't make investments for short term gains.

Mr. Perkel: Well, let me put it this way then. If the Secretary of Labor were to adopt the proposed standard,

would you consider that to be a short term increase in demand that you would not expand your capacity for?

Mr. Hocutt: Yes. We would consider anything related to this cotton dust standard as a relatively short term thing. We would expand our capacity as I have already said within the limits of our plant. We would not build a [2515] bigger plant. We would not buy more machinery for a business that has a limited life. Because after the industry more or less reaches a standard, then the amount of business would be very small, of course.

Mr. Perkel: You use the term, limited life and short term. Would you define those in terms of years?

Mr. Hocutt: Well, let me say this, Mr. Perkel. The Pneumafil Corporation is not going to expand its plant for textiles whatever is decided by OSHA.

Mr. Perkel: You are not answering my question, sir.

Mr. Hocutt: Yes, I am. I am answering your question because I am saying to you, under whatever condition you say, Pneumafil Corporation will not expand its plant for the textile yarn manufacturing equipment that we sell now because it just doesn't justify any larger operation that we have already.

[2565] * * *

QUESTIONING OF JOHN P. FIGH

BY DAVID LESOURD

Informal Public Hearing on Proposed Standard for Exposure to Cotton Dust April 28, 1977.

* * *

Dr. Lesourd: There are quotas, are there not?

Insofar as we know anyway of what the future will hold, won't these quotas tend to limit the amount of imports, then?

Mr. Figh: Well, the way I understand the present agreement that is being renegotiated now, that the imports are allowed to grow at six percent and our own industry is growing say at roughly at less than that, four to four and a half percent and I think my figures may be a little on the high side.

The penetration of imports will increase as a percentage of the domestic market.

Dr. Lesourd: I think that these figures that we have been using are for textiles as a whole, are they not?

Mr. Figh: Right.

Dr. Lesourd: Does the same situation apply to [2566] cotton textiles, cotton blends?

Mr. Figh: I have not analyzed it, but I suspect that the cotton blends and the cotton fabrics both would be subject to a greater penetration from the imports than certain other products and I think one of the reasons is that a lot of imports come in in the lightweight apparel that is often made up of blends and they have a bigger share of the industry than the overall industry figure.

[2568] * * *

Dr. Lesourd: Yes sir. But I think the point I am trying to get at is that if as a result of costs that apply across the board to all textile firms tending to process cotton, if these lead to a general increase in the cost of products containing cotton, then there would be available an added flow of revenue, would there not, to the cotton textile firms? And this would tend to provide funds to finance the investment would it not? As a banker, wouldn't you consider this as part of the revenue that you would be looking for before you—

Mr. Figh: Well, I think you are looking at the saving that would be made by each individual company, I think we

would look at it case by case and how the investment would effect the cash flow of a company and I think that is really the major point. If it could be passed on I [2569] suppose so, but I would have severe reservations that it can.

And again the thing is that it goes down to certain individual companies and certain individual plants are going to bear more than their share of the burden and it is a question of whether they can be economically viable.

* * *

[2570] Dr. Lesourd: I don't think on the basis of the testimony we have heard that I know at least to what extent that is so, but regardless of—are you discounting the possibility of price increases in finished cotton textiles or the products made from cotton textiles?

Mr. Figh: I think there to a certain degree I am because again, you mentioned imports and we are talking in a context of a world market where you are competing against companies of the Far East who have no standards at all, they have no safety standards to the degree that we do. Labor I hear different figures, but say the direct labor cost is a third of what ours is, they don't have the fringe benefits that we have.

And one thing or another, so you are competing in a world market that doesn't have the same standards that we do.

Dr. Lesourd: This is true, but isn't it also true that so long as the present pattern of quotas exists probably the growth of imports will be about what is already anticipated?

Mr. Figh: Well: I really can't speculate on how the negotiations that are going on right now, they are probably in a rather delicate stage, but what the probability of them being continued, tightened or loosened, I don't know, but

if you take the assumption that they will continue to grow at [2571] six percent, people that can produce it cheaper are going to bring it in and it is going to have a decided pressure on the ability to raise prices.

* * *